

**The role of defence science
in achieving Australian
self-reliance**

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CONTENTS

ACKNOWLEDGEMENTS	iii
ABSTRACT	v
GLOSSARY	vii
CHAPTER 1 INTRODUCTION	1
CHAPTER 2 DEFENCE POLICY—THE IMPACT ON DEFENCE SCIENCE	7
Science and Technology	7
White Papers and Government Reviews	8
1945–1952—imperial defence to forward defence	9
1952–1972—decline of forward defence	12
1972 White Paper—post Guam doctrine	14
1976 Defence White Paper	15
1986 Dibb Review and 1987 Defence of Australia White Paper	19
1993 Strategic Review and 1994 Defending Australia White Paper	26
1997 Australia’s Strategic Policy	31
2000 White Paper	33
Summary	34
CHAPTER 3 THE CONCEPT OF SELF-RELIANCE	37
Self-Reliance	38
External Influences on Self-reliance	45
Revolution in military affairs	45
Compatibility and interoperability	50
Global defence industry trends	53
CHAPTER 4 THE DEVELOPMENT OF DEFENCE SCIENCE	59
The Genesis of DSTO	59
DSTO: Inside Defence	64
DSTO’s External Defence Interactions	68
DSTO and Industry Relationship	70

CHAPTER 5 DSTO INPUT INTO DFENCE PROGRAMS—CASE STUDIES	75
Jindalee Over the Horizon Radar	75
Background	75
Strategic context	77
Industry	79
Self-reliance	82
Collins Submarine	83
Background	83
Strategic context	84
Self-reliance	85
Alliance versus independence	89
External factors affecting the development of the Collins-class	90
CHAPTER 6 CONCLUSION	93
BIBLIOGRAPHY	99

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ABSTRACT

Self-reliance is a principle upon which Australian defence policy is based. It is broadly interpreted as providing Australia with an independent defence posture. Many defence activities, including defence science, contribute to self-reliance. But the term offers little utility when evaluating a range of defence activities and decisions for adherence to the principle of self-reliance. In this monograph the concept is analysed and the definition offered by Dibb in 1986, that 'limits' the goal of self-reliance to low-medium level conflicts, and the capability, both militarily and industrially to support this, is essentially adopted. The role of defence science in achieving self-reliance is examined in this context. From colonial times up until the end of the Second World War, defence science closely supported Australian industry. When the Defence Science and Technology Organisation (DSTO) was formed in the mid-1970s after the Tange re-organisation of Defence, the alignment with defence policy and priorities increased. The 1986 Dibb Review signalled the beginning of a period in which the notion of self-reliance was subject to some rigour. Also at this time there was a significant increase in defence industry activity, all of which was carried out under the mantle of increased self-reliance. Two projects with significant DSTO input, the Jindalee Operational Radar Network and the Collins-class submarine, are examined for their contribution to self-reliance. Both projects are shown to support the broad principle of self-reliance but under the limited definition, the ability to maintain, repair and modify systems, is arguably more effective than designing and/or building limited numbers of platforms. The industry element of self-reliance is shown to rely on DSTO, but calls for increased interaction appear to go unheeded as DSTO increasingly aligns itself with broad scientific support to the ADF. Exogenous constraints on self-reliance such as the Revolution in Military Affairs and global industry trends increase the requirement for DSTO input but limited resources make this goal difficult to achieve.

GLOSSARY

AAMOUR	Anglo–Australian Memorandum of Understanding on Research
ADC	Australian Defence College
ADF	Australian Defence Force
ADFA	Australian Defence Force Academy
ADSC	Australian Defence Studies Centre
ADSS	Australian Defence Scientific Service
AEL	Advanced Engineering Laboratory
AEW&C	Airborne Early Warning and Control
AGPS	Australian Government Publishing Service
AMRL	Aeronautical and Maritime Research Laboratory
ANU	Australian National University
ANZUS	Australia, New Zealand and the United States
APSC	Air Power Studies Centre
ARL	Aeronautical Research Laboratories (after December 1987 changed to Laboratory)
ASC	Australian Submarine Corporation
ASCC	Air Standardisation Coordinating Committee
ASTEC	Australian Science and Technology Council
AWA	Amalgamated Wireless (Australasia)
BMDO	Ballistic Missile Defense Organisation (US)
CAARC	Commonwealth Advisory Aeronautical Research Council
CAC	Commonwealth Aircraft Corporation
CCT	Community Consultative Team
CDS	Chief Defence Scientist
COTS	Commercial-Off-The-Shelf
CRC	Cooperative Research Centre
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTD	Capability and Technology Demonstrator
DER	Defence Efficiency Review
DERA	Defence Evaluation and Research Agency (UK)
DMO	Defence Materiel Organisation
DRCS	Defence Research Centre Salisbury
DSL	Defence Standards Laboratories
DSTO	Defence Science and Technology Organisation
ERL	Electronics Research Laboratory
ESRL	Electronics and Surveillance Research Laboratory
FPDA	Five-Power Defence Arrangement
GAF	Government Aircraft Factory
HQADF	Headquarters Australian Defence Force

IT	Information Technology
JORN	Jindalee Operational Radar Network
J-STARS	Joint Surveillance Target Attack Radar System
JTTRE	Joint Tropical Trials Research Establishment
LADS	Laser Airborne Depth Sounder
LRWE	Long Range Weapons Establishment
MOU	Memorandum of Understanding
MRL	Materials Research Laboratory
NAMRAD	Non-Atomic Military Research and Development
NATO	North Atlantic Treaty Organisation
OTHR	Over-the-Horizon Radar
PDC	Project Development and Communications (Division)
PGM	Precision Guided Munition
RAAF	Royal Australian Air Force
RANRL	Royal Australian Navy Research Laboratory
R&D	Research and Development
RDRC	Research and Development Requirements Committee
RMA	Revolution in Military Affairs
RTO	Research and Technology Organization
SDSC	The Strategic and Defence Studies Centre, ANU
SEATO	South East Asia Treaty Organisation
SME	Small to Medium Enterprises
SRL	Surveillance Research Laboratory
STOL	Short Take-Off and Landing
TTCP	The Technical Cooperation Panel
UAV	Uninhabited Air Vehicle
WRE	Weapon Research Establishment
WRESAT	Weapon Research Establishment Satellite
WSRL	Weapons System Research Laboratory

CHAPTER 1 INTRODUCTION

This monograph introduces a number of propositions that relate to the role of defence science in achieving self-reliance. That defence science contributes to self-reliance may not appear contentious. But critical examination of this connection is a relatively recent phenomenon, particularly when compared to the first scientific support to the colonial armed forces in the late 1880s. Four questions will be posed with the aim of examining the notion of self-reliance, the depth of the concept, as well as influences that may strengthen or diminish its influence. Finally, two case studies have been chosen to test the proposition that defence science does contribute to self-reliance.

How is self-reliance defined in the Australian context? Self-reliance has been part of Australian government defence policy thinking since the early 1970s. Defence White Papers, released at random intervals, publicly announce government policy. The first formal articulation of self-reliance occurred in the 1976 White Paper. Significant refinement took place in the mid-1980s and the evolution has been broadly accepted to the point where in the 2000 White Paper, self-reliance is one of three principles used to shape the approach of meeting the priority task of the Australian Defence Force (ADF)—the defence of Australia.¹ Throughout this analysis, defence policy and in particular its influence on defence science and technology will be examined. A definition of self-reliance will be offered, including the influence brought to it by the alliance with the US. Inconsistencies in the usage of the term in the defence literature will also be noted. A 'limited' definition appears to offer more utility when evaluating a range of defence activities and decisions for their adherence to the principle of self-reliance.

What elements comprise self-reliance? The Fraser government introduced the notion of self-reliance into the policy debate. The seminal 1986 Dibb Review² provided limits to self-reliance with regard to capability decisions. Beazley, the Minister for Defence at the time, went on to develop a model

¹ Commonwealth of Australia, *Defence 2000—Our Future Defence Force*, Defence Publishing Service, Canberra, December 2000, p. xi. Hereafter abbreviated to 2000 White Paper.

² Paul Dibb, *Review of Australia's defence capabilities*, AGPS, Canberra, 1986. Hereafter abbreviated to Dibb Review

that would provide a framework and arguably some intellectual rigour to the previously vague notion. The late 1980s and early 1990s were significant periods in the pursuit of self-reliance, particularly the development of industry for defence. While definitions or refinements of the term were not forthcoming, defence analysts such as Cheeseman and Dibb continued to ply the concept. During this period the role of defence science and technology was increasingly seen to contribute to self-reliance.

The genesis of defence science in Australia grew out of support for industry associated with defence activities, initially ammunition manufacture and by the Second World War, technologically advanced aircraft industry. The links between defence science and industry were based on the broad principle of self-reliance but the relationship changed after the Second World War when industry was faced with excess capacity and a strategic outlook dominated by the Cold War. The relationship between Defence Science and Technology Organisation (DSTO) and industry has been the subject of many reviews. The reviews and subsequent policy directives resulted in calls for increased interaction. There is little evidence to suggest that these calls have been successful. DSTO's relationship with industry is examined in detail in this monograph.

While the role of DSTO and industry was often hotly debated, the White Papers and Strategic Reviews on occasions identified significant new trends or issues. For example, the 'knowledge edge'³ and the Revolution in Military Affair (RMA) were introduced into the policy arena for the first time in the 1997 Strategic Review.⁴ Defence science was expected to develop skills in these new areas so as Australia could have independent capabilities. These

³ The knowledge edge is 'the effective exploitation of information technologies to allow us to use our relatively small force to maximum effectiveness', from Commonwealth of Australia, *Australia's Strategic Policy*, Defence Publishing and Visual Communications, Canberra, December 1997, p. 56. Hereafter abbreviated to ASP97.

⁴ The 1997 Strategic Review is often loosely referred to as the 1997 'White' Paper. ASP97 was in fact a Strategic Review which is a more frequently, but rarely publicly available, shorter-term assessment of the security environment.

new directions pursued DSTO to cover a very broad range of scientific endeavours⁵ requiring a highly skilled work force for both competency development and project maturation. In this monograph the formal defence policy is reviewed and the impact it had on the direction of defence science policy is discussed.

What are the endogenous and exogenous constraints upon self-reliance? While self-reliance is central to defence science policy makers, it is argued that constraints, both domestic and external, impact on the goal of self-reliance. The factors include declining defence budgets in the industrialised world during the 1990s, and the reduction in the number of defence manufacturers due to transnational and national mergers resulting in reduced choice and restrictions in foreign ownership. The latter leads to a range of issues, including technology transfer restrictions.⁶ Other external influences include the Revolution in Military Affairs⁷, the US Alliance—particularly with regard to compatibility and interoperability—and global trends such as transnational mergers.

⁵ The DSTO objective is 'to give advice that is professional, impartial and informed on the application of science and technology that is best suited to Australia's defence and security needs.' DSTO activities include:

- Influencing the framing and implementing of defence policy for the use of science and technology;
- Positioning Australia to exploit future developments in technology which show promise for defence applications;
- Ensuring that Australia is an informed buyer of its defence equipment;
- Developing new capabilities, especially where there are special national demands including those related to Australia's unique environment;
- Supporting existing capabilities by increasing operational performance and reducing the costs of ownership;
- Working with industry to enhance Australia's defence capabilities and to contribute to national wealth creation, including through the support of exports; and
- Collaborating internationally, both regionally and with Australia's traditional friends and allies, and in support of the Government's broader international objectives.

From <http://www.dsto.defence.gov.au/corporate/mission.html>, 17 July 2000.

⁶ There are a range of endogenous influences on defence science that are beyond the scope of this work. Nevertheless, they are significant in influencing the responsiveness of research organisations such as DSTO. These influences contribute to claims that defence science programs are directed away from the combat end of the Australian Defence Force into endless 'paper' studies; that programs are slow to change directions and that transfer technology to industry is slow. Contributing factors to these views include staff constraints, such as specialised training (particularly the requirement for PhDs for research scientists), Public Service inflexibility and the inherent risk in research: no definite outcomes; pressure to perform service instigated work to the detriment of the basic research that provides the foundations for future advances.

⁷ Dibb summarises the elements of the current RMA as, 'dramatic advances in fire-power, accuracy and the ability to detect targets'. From Paul Dibb, 'The Revolution in Military Affairs and Asian Security', *Survival*, Vol. 39, No. 4, 1997–98, p. 93.

How effective have Australia's attempts at achieving self-reliance been? Two major Australian industry projects that involved DSTO are examined for their contribution to the various elements of self-reliance. The JORN over the horizon radar and the Collins-class submarine are presented as case studies. The projects are tested for compliance with the defence policy directives. It is worth noting here that if non-defence policy reasons prevail, they may diminish the broad aims of defence strategic policy.

Chapter 2 examines defence policy since the Second World War, particularly the influence upon defence science. White Papers and various government reviews relating to both the defence and science environment are reviewed. In Chapter 3, a definition of self-reliance is proposed and both endogenous and exogenous influences are examined for their impact on the goal of self-reliance. Influences examined include the RMA, compatibility and interoperability requirements and global defence industry trends. Chapter 4 unpacks the genesis of DSTO and its evolution into the Department of Defence. External defence relationships including international agreements are examined, as well as those with industry. Chapter 5 consists of two case studies which involve DSTO input into major defence programs, both of which claim to contribute to Australia's self-reliant defence posture. Chapter 6 presents conclusions drawn from the research and analysis.

The significance of the analysis lays in the proposition that Australian defence policy has evolved to a point where self-reliance is a guiding principle for the ADF's primary task of defending Australia. The role of science and technology to support the ADF and the defence industry is both implicit and explicit. The goal of self-reliance is rarely challenged. Yet the policy aim has been diminished by external influences. These influences may impact three of the tenets of Australian security planners: self-reliance, the alliance (and the subsequent requirement for a modern interoperable force) and a technology edge.⁸ The limited science and technology budget demands careful targeting of research fields. Global trends identified will be examined

⁸ Hugh White, 'Is Defence Self-Reliance Still Realistic', *Journal of the Royal United Services Institute of Australia*, Vol. 17, November 1996, p. 57.

to see if they dilute the research effort to the point that they do not contribute effectively to a self-reliant defence posture. The self-reliance aspect of security is often accepted but not well understood. The monograph will establish a clear connection between self-reliance and defence science and technology policy. Two large defence projects, both with significant DSTO input are analysed to evaluate the extent to which the projects have contributed to self-reliance. This is of importance to Australian defence planners as it will lead to the establishment of guidelines as to the importance and priority of the broad defence science fields of research to effectively contribute to the goal of self-reliance.

CHAPTER 2 DEFENCE POLICY—THE IMPACT ON DEFENCE SCIENCE

This chapter outlines the development of a definition of defence science and an examination of the relationship between defence science, the defence force and industry and the evolution of the principle of self-reliance.⁹ A brief history of the development of Australian White Papers will be given from the period after the Second World War. The emphasis of this historical summary will be on Australian defence policy and the impact of the principle of self-reliance on the science and technology contribution to the ADF and industry. A detailed review will be conducted on the five White Papers produced during the last quarter of a century—1972, 1976, 1987, 1994 and 2000.¹⁰ Additionally, government initiated reviews with a significant impact on DSTO will also be examined. The Dibb Review marked a significant point in Australian defence policy planning, hence particular emphasis is given to this report.¹¹ Dibb provided the foundation stone for subsequent defence policy in relation to self-reliance and the maintenance of the technological edge for the ADF.

Science and Technology

Science is a particular branch of knowledge. The Macquarie dictionary states that science is:

The systematic study of man and his environment based on the deductions and inferences which can be made, and the general laws which can be formulated, from reproducible observations and measurements of events and parameters within the universe.

Technology can be simply defined as applied science. It is the branch of knowledge that deals with science or engineering, or its practice, as applied to industry.¹² The genesis of defence science and technology in Australia can be traced back to the manufacture of ammunition. Wisdom provides a

⁹ Self-reliance will be initially viewed as simply independence.

¹⁰ The 1997 Strategic Review will also be studied in detail due to its significance, including the public nature of its release.

¹¹ The debate generated by the Dibb Review was widespread and the principle of self-reliance was confirmed in 1987 by the policy information paper, *The Defence of Australia*. Commonwealth of Australia, Department of Defence, *The Defence of Australia: 1987*, AGPS, Canberra, 1987. Hereafter abbreviated to 1987 White Paper.

¹² A more detailed summary of science and technology definitions can be found in A.L.G. Rees, *Independent External Review of the Defence Science and Technology Organisation*, AGPS, Canberra, October 1980, p. 11.

summary of the history of defence science from its colonial roots through to the Departments of Defence's DSTO.¹³ It is clear that defence science was strongly tied to the support of the defence industry up until the end of the Second World War. After the war, defence science gradually became aligned with the Department of Defence and this arguably led to a reduction in the interaction with defence industry.¹⁴

White Papers and Government Reviews

White Papers articulate government defence policy. The strategic basis series of papers are released at more frequent intervals and have an outlook of 3–5 years but are generally not published.¹⁵ The public disclosure of White Papers provides transparency both domestically and regionally,¹⁶ to the outcomes and the process of defining defence policy.¹⁷

¹³ For details refer to John Wisdom, *A History of Defence Science*, DSTO, Melbourne, 1995. For elaboration of defence science and technology in the context of Australian industry refer to Frank Cain, (ed.), *Arming the Nation: a history of defence science and technology in Australia*, Australian Defence Studies Centre, ADFA, Canberra, 1999.

¹⁴ The role of defence science is put into context of the broader Australian technological development in John Farrands and John Wisdom, 'Defence Science and Technology', in Frank Eyre, (ed.), *Technology in Australia 1788–1988*, Australian Academy of Technological Science and Engineering, Melbourne, 1988, pp. 917–74.

¹⁵ The 1990 strategic basis paper, Australia's Strategic Planning in the 1990s, was published in 1992, three years after its initial release. The Minister for Defence, Robert Ray, stated that this was part of the Labor government's desire for increased openness of the decision making processes. Commonwealth of Australia, *Australia's Strategic Planning in the 1990s*, Defence Departmental Publications, Canberra, September 1992, p. iii. (original paper endorsed 27 November 1989).

¹⁶ Past and present papers have also been briefed to foreign governments. Articles have appeared in regional publications to stimulate debate and gain transparency. For the 2000 White Paper release, refer to Peter La Franchi, 'Hard Times for Australia', *Asian Military Review*, Vol. 8, No. 4, July 2000, pp. 43–46.

¹⁷ A plethora of states in the region have produced White Papers, ranging from China to Korea. Others have approached the end state by different means. New Zealand, for example, produced a report by the Foreign Affairs, Defence and Trade Committee and upon a change of government, the findings of the inquiry were then to be adopted in a wholesale manner. Interestingly the ensuing reviews of defence policy, especially force structure, have been less than smooth. Refer to Derek Quigley, *Inquiry into Defence Beyond 2000*, Wellington, August 1999; Christopher Dore, 'NZ settles for "fewer bangs"', *Australian*, 22 August 2000, p. 2. Another point to consider was the 1972 White Paper of the Coalition government. The Deputy Leader of the Opposition response to parliament was fundamentally accepted by the new Labor government in 1972. A new White Paper was not produced until 1976. Lance Barnard, *Statement on Defence (White Paper)*, Ministerial Paper 541, Canberra, 11 April 1972.

Rear Admiral Walls noted, after the release of the 1994 White Paper,¹⁸ that they:

[A]re not intended to provide guidance on national security, rather they provide a detailed and comprehensive explanation of Australia's policies on defence, and how they will respond to change in our strategic environment.¹⁹

Defence policy has a number of audiences, and these include; the Defence Department in all its forms (including the DSTO), other government departments,²⁰ and the wider public.²¹ The other important audience is that of the regional and global community. Policy articulation via a White Paper signals an intention and forms the basis for subsequent actions. The openness aids in easing tensions based sometimes on misunderstandings.²² Other defence reviews are usually conducted in response to public concerns or to advocate or reinforce policy decisions.

1945–1952—imperial defence to forward defence

After the Second World War, Australia's geo-strategic position dictated the need for a major ally. While Australia was tied to Britain, the strategic priority of Britain was focused on the Middle East and Europe.²³ Australia, as

¹⁸ Commonwealth of Australia, Department of Defence, *Defending Australia*, AGPS, Canberra, 1994. Hereafter abbreviated to 1994 White Paper.

¹⁹ R.A.K. Walls, 'Defending Australia—The 1994 Defence White Paper', *Journal of the Royal United Services Institute of Australia*, Vol. 16, No. 1, November 1995, p. 1.

²⁰ This is particularly important when Australia puts forward the 'whole of government' position.

²¹ The public have been offered the chance to be involved in the security debate. At times those involved revert to broader, morally driven issues, such as disarmament, health-care rather than reference to direct defence issues. Robert Garran, *The Australian's* defence writer, points out that the participants in the current Review Meetings have been generally older citizens, with strong participation by organisations such as the RSL and RUSI. See *Australian*, 31 July 2000, p. 2.

²² This appears particularly appropriate given the concerns expressed by Indonesia regarding Australia's sudden change in policy over the status of East Timor in 1999. Additionally, comments leading to even looser interpretations of the 'Deputy Sheriff' created unnecessary tensions in the region. Diplomatic subtleties may still be lost even with the public discussion paper. For example, Indonesian General Fachrul Razi 'voiced objections to the depiction of West Papua as an area of potential strategic concerns' after a Green Paper briefing. See, Don Greenlees, *Australian*, 14 August 2000, p. 7.

²³ Australia's ties with Britain were based on trade as well as the more obvious historical and social links. While the Middle East was, inter alia, a source of oil the Britain, Europe provided a less certain partner due to its political unreliability after the war. On this point, refer to John Darwin, 'Britain's Withdrawal from East of Suez', in Carl Bridge, (ed.), *Munich to Vietnam: Australia's relations with Britain and the United States since the 1930s*, Melbourne University Press, Melbourne, 1991, p. 142.

a Dominion, was expected to contribute to any major British conflict.²⁴ For Australia, the most prominent issue of the time was the perceived threat of Communism.²⁵ Essentially, Menzies and the British diverged in their views as to the relative importance of Asia and the Middle East. As would be expected, Australia was more concerned with Asia as a source of threat. Sir Frederick Shedden, the Secretary of the Australian Department of Defence, was worried that Britain could not cope with an outbreak of conflict in Europe and these two more distant regions. Shedden's view was instrumental in Australia courting the US as the major alliance partner.²⁶ The result was the signing of the ANZUS treaty in 1951.²⁷ This marked a turning point in Australia's security.

With Menzies regaining the Prime Ministership in 1949 and continuing up until 1966, this period can be seen as a transition to a more independent Australian security posture albeit with the aid of the developing US alliance. But the relationship with Britain was still pre-eminent.²⁸ The changes from

²⁴ 'In the event of war Britain would want immediate Australian assistance in a front extending from Iceland to the Middle East', from Ritchie Owendale, 'The Cold War, 1949–1951', in Carl Bridge, (ed.), *Munich to Vietnam: Australia's relations with Britain and the United States since the 1930s*, p. 88

²⁵ The Defence Reports of the late 1960s and the early 1970s indicate the depth of this concern. For examples, refer to Commonwealth of Australia, Department of Defence, *Defence Report 1971*, AGPS, Canberra, 1972, p. 3; Commonwealth of Australia, *Defence Report 1969*, AGPS, Canberra, 1970, p. 4; Commonwealth of Australia, *Defence Report 1967*, AGPS, Canberra, 1968, p. 5.

²⁶ The Hon. Peter Reith, Minister for Defence, presented a paper at a 50th Anniversary ANZUS Conference where he argued Percy Spender's influence in proposing the ANZUS Treaty. Reith also gives a potted history of the alliance. Peter Reith, 'Address to ANZUS Conference', University of Sydney, unpublished, 30 June 2001.

²⁷ Critiques of the alliance can be found in Gary Brown, *Australia's Security: Issues for the New Century*, Australian Defence Studies Centre, ADFA, Canberra, 1994, pp. 107–35; Coral Bell, 'The ANZUS Alliance: The Case For', in Desmond Ball and Cathy Downes, (eds), *Security and Defence: Pacific and Global Perspectives*, Allen and Unwin, Sydney, 1990, pp. 221–31; Gary Brown, 'The ANZUS Alliance: The Case Against', in Ball and Downes, (eds), *Security and Defence: Pacific and Global Perspectives*, pp. 232–49.

²⁸ Menzies is credited with establishing Australia's foreign policy during this period on three tenets: first, friendship with Great Britain; second, friendship with the United States not inconsistent with the deep affection for the mother country and sister nations; and third, mutual understanding between the United States and the Commonwealth countries.' From Brian Avery, 'Menzies' Foreign Policy and the Empire Ideal', in McCarthy, John, (ed.), *Dependency? Essays in the History of Australian Defence and Foreign Policy*, Defence Studies Publication No. 1, ADFA, Canberra, undated, p. 41. This is paraphrased from Percy Joske, *Sir Robert Menzies*, Angus and Robertson, Sydney, 1978, p. 265.

'Imperial Defence' to a 'forward defence' posture—sending forces offshore to 'defend' Australia's national interests, not that of the Empire—was perhaps best exemplified by the Australian involvement in Korea.²⁹

The requirement for much of the capacity of the defence industry after the Second World War dropped off rapidly resulting in a reduction of the infrastructure. Prime Minister, J. B. Chifley, reported to the Dominion Prime Ministers Conference in London in 1946 that Australia was keen to maintain a level of self-reliance—especially given the difficulties Britain was facing after the war. He envisaged that, 'Australia [would seek] to provide the widest possible base for a supply structure for the needs of the Empire in the Pacific'.³⁰

The relationship with Britain and the consequences on defence science are exemplified by the impact of two conferences held in London during 1946. The aim of the conferences were to combine the efforts of the British Commonwealth for the benefit of the Commonwealth. Firstly, as a result of the Commonwealth Defence Science Conference, the prospect of Australia supporting the British atomic and ballistic weapon programs was raised and this ultimately led to the creation of the Weapons Research Establishment at Salisbury in South Australia.³¹ Secondly, the Commonwealth Aeronautical

²⁹ As an example of the changing relationships the Australian military began to source more weaponry from the US rather than Britain. As a practical example of the changing allegiances, Australian CAC-built North American Sabre replaced the RAAF-operated British Gloster Meteors fighter aircraft in 1954, albeit with a British-designed Rolls-Royce Avon engine. The new aircraft were too late for action in Korea. Maurice Allward, *F-86 Sabre*, Ian Allan, London, 1978, p. 81. For an account of Australia's involvement in the Korean War (1950 to 1953) see Norman Bartlett, (ed.), *With the Australians in Korea*, 3rd edn., Australian War Memorial, Canberra, 1960.

³⁰ Wisdom, *A History of Defence Science*, p. 59. For elaboration see Christopher Waters, *The Empire Fractures—Anglo-Australian Conflict in the 1940s*, Australian Scholarly Publishing, Melbourne, 1995, p. 64.

³¹ The Defence Science Conference would appear to have had a successful outcome, from a British perspective particularly, in the Joint Project. The Woomera rocket range, the support facilities at the current DSTO Salisbury complex, and the atomic tests conducted in the South Australian desert were tangible outcomes. While the atomic weapons tests had a lasting impact on Australia. Australia did benefit from the ballistic missile testing infrastructure in addition to the rapid development of high technology facilities. For a detailed analysis of the direct and indirect benefits of the Joint Project refer to the 'Epilogue' in Peter Morton, *Fire Across the Desert: Woomeras and the Anglo-Australian Joint Project*, AGPS, Canberra, 1989, pp. 543–52.

Research Conference led to the establishment of the Commonwealth Advisory Aeronautical Research Council (CAARC)³² and this provided direction to the Aeronautical Research Laboratories (ARL) research programs.³³ These two actions indicated the influence of the British on Australian defence science policy for purposes that, in some cases, would appear difficult to relate to Australia's direct strategic interests.

1952–1972—decline of forward defence

This period is notable for the British withdrawal from Asia and the Australian sliding involvement in Vietnam. The initial military deployment commenced in 1962. In 1964 the RAAF committed Caribou transport aircraft.³⁴ By 1966, Australia's military contribution had built up to 8000 but there was 'growing dissent among the Australian population'.³⁵ The period was one in which Australia found itself in a relationship with two 'partners'. The British relationship was important, yet Australia was very aware that the new relationship with the US demanded a show of commitment. On the one hand, the Malay crisis, Britain's last substantial engagement in Asia,³⁶ involved Australian forces but soon after 1967 the British announced the withdrawal from East of the Suez.³⁷ On the other hand, the Australian commitment to Vietnam was popular with the US administration because of the show of support, but the depth of the initial relationship was arguably less substantial.³⁸ This period was the apex of 'forward defence'.

³² CAARC was comparatively less successful and this, along with the changing emphasis on Commonwealth relations led to the Councils demise in 1993. From private communications with last Australian CAARC representative, Neil Pollock, 3 August 2000.

³³ As an example, the terms of reference for ARL in the late 1950s were '(a) To carry out aeronautical research applicable to Australia's defence requirements. (b) To apply this research where appropriate to the general defence programme of the British Commonwealth. (c) To offer assistance in appropriate fields to Australian industry and national development.' The commitment to the British Commonwealth was dropped in the 1960–61 Annual Report. See Commonwealth of Australia, Department of Supply, *Aeronautical Research Laboratories Annual Report 1958–59*, ADSS, Melbourne, 1959, p. 5; Commonwealth of Australia, Department of Supply, *Aeronautical Research Laboratories Annual Report 1960–1961*, ADSS, Melbourne, 1961, p. 4.

³⁴ George Odgers, *Mission Vietnam*, AGPS, Canberra, 1974, pp. 1–9.

³⁵ T.B. Millar, 'Vietnam', in Carl Bridge, (ed.), *Munich to Vietnam: Australia's relations with Britain and the United States since the 1930s*, p. 192.

³⁶ The 1967 British White Paper indicated the "considerable reductions" in overseas colonial garrisons' but this was the last, and in many ways 'remarkable expansion of the British defence commitments' prior to the announcement of the withdrawal of the British from East of Suez. As discussed in Darwin, 'Britain's Withdrawal from East of Suez', pp. 145–46.

³⁷ The Australian sentiment is captured by Millar when he states, 'Australia also felt let down by the British decision to withdraw from East of Suez—a decision foreshadowed in 1966, taken in principle in April 1967 and finally announced in January 1968.' From Millar, 'Vietnam', p. 185.

³⁸ Bridge states that '[the] anticipated move from one dependency to another did take place, but only gradually and with qualifications' from Carl Bridge, 'Perspective', in Carl Bridge, (ed.), *Munich to Vietnam: Australia's relations with Britain and the United States since the 1930s*, p. 196.

The involvement in Vietnam raised the issues of self-reliance and compatibility with US forces. Support for possible deployment of the French Mirage fighter aircraft was of significant concern to the Air Board,³⁹ especially after Sweden's refusal to supply ammunition for the Carl Gustav 84mm anti-tanks gun used by the Australian Army.⁴⁰ The 'forward defence' strategy of this period resulted in Australia increasing its dependence on the US. Australia's contribution to the US alliance was by way of maintaining a well-trained, interoperable force that could fit into a larger allied force. In return, Australia gained a general guarantee of security from a 'common' threat—communism.⁴¹

President Nixon announced at Guam in 1969 that the US would not again deploy ground troops in the Asia–Pacific region and that US allies in the region would be expected to provide their own defences in regional disputes.⁴² The long-standing 'forward defence' posture came under severe pressure due to Nixon's announcement and Australia's politically and socially divisive involvement in, and subsequent withdrawal from, the Vietnam War.

In terms of defence science policy, the period was notable for the continuing support to British driven weapons programs and the space industry centred on Woomera and Salisbury. The period is not notable for defence science focusing on Australian military operations in the region or the evolving changes to the strategic environment.

³⁹ The Mirage aircraft was licence-built in Australia but French support was still required. At Air Board meetings in September and October 1967 the problems of deployment were discussed. For elaboration see Chris Coulthard-Clark, *The RAAF in Vietnam*, Allen and Unwin, Sydney, 1995, p. 92.

⁴⁰ At a higher level, the US Administration and the Pentagon were concerned with the ability of Australia to fit into the US operations in Vietnam. One aspect of the interoperability of US and Australian forces would have been equipment compatibility. For elaboration on US concerns see T.B. Millar, 'Vietnam', p. 187.

⁴¹ The threat from Australia's perspective was one of isolation, from 'friends and allies', if Soviet or Chinese backed communists came to power in Southeast Asia. Robyn Lim, 'Australian Security After the Cold War', *Orbis*, Vol. 42, No. 1, 1998, pp. 93–4.

⁴² Graeme Cheeseman, *The Search for Self-Reliance*, Longman Cheshire, Melbourne, 1993, p. xv.

1972 White Paper—post Guam doctrine

As a result of Nixon's announcement, Australian defence planners were required to consider an independent defence posture based on the defence of Australia. As O'Neill observes, 'in 1971 and 1972 Australia was too heavily enmeshed in the Vietnam war for there to be much interest in the defence of Australia per se.'⁴³ The 1971 and 1973 Strategic Basis papers continued the argument that the US would come to Australia's aid in the face of a 'massive' threat.⁴⁴ The links with the US would facilitate our newly found regional role both indirectly and directly.⁴⁵ Direct help would be a result of the 'access [the US] gave to classified defence technology, doctrine, logistics support arrangements and intelligence and policy considerations, as well as joint exercising and training'.⁴⁶

In December 1972 the 26 year run of the Coalition government ended. The White Paper released earlier in the year was never part of government policy.⁴⁷ Labor, when in opposition produced a statement on the White Paper that alluded to significant similarities, claiming that the government policies 'could have been lifted intact from the Labor Party platform.'⁴⁸ The primary differences should be noted as they reflect a change from the 'forward defence' policy to one of defence of Australia. As Barnard stated, 'the old policy of forward deployment is now labelled the selective forward deployment of forces.'⁴⁹ The underlying tenet of the Labor government was to develop a more independent defence stance.⁵⁰ The Coalition's White Paper made reference to an 'increasing self-reliant military strength' and the role of industry in achieving self-reliance.⁵¹ The lack of clear policy on science and technology or self-reliance should be viewed in the context of the 'quite breathtaking' changes initiated by the Labor government.⁵²

⁴³ Robert O'Neill, (ed.), *The Defence of Australia—fundamental new aspects*, ANU, Canberra, 1976, p. vi.

⁴⁴ Cheeseman, *The Search for Self-Reliance*, p. 174.

⁴⁵ The indirect support would result because 'Australia's views would carry the imprimatur of Washington'. For more detail see Cheeseman, *The Search for Self-Reliance*, p. 174.

⁴⁶ Cheeseman, *The Search for Self-Reliance*, p.174.

⁴⁷ Commonwealth of Australia, Department of Defence, *Australian Defence Review*, AGPS, Canberra, March 1972. Hereafter abbreviated to 1972 White Paper.

⁴⁸ Barnard, *Statement on Defence (White Paper)*, p. 2.

⁴⁹ Barnard, *Statement on Defence (White Paper)*, p. 11.

⁵⁰ The Barnard statement raised issues including the ending of conscription; reinforcing no Australian nuclear weapon capability; withdrawal back to Australia of forces involved in the 'moribund' SEATO and FPDA; and ending the secrecy surrounding the US bases in Australia. Significant effort was put into the statement to allay public fears of an immediate undoing of long time alliances, agreements and commitments. Barnard, *Statement on Defence (White Paper)*, pp. 10–11, 17–20, 28.

⁵¹ 1972 White Paper, pp. 2, 33.

⁵² Cheeseman, *The Search for Self-Reliance*, pp. 4–9.

1976 Defence White Paper

The 1976 Defence White Paper, *Australian Defence*, was released at the end of the new Coalition government's first year and it was the first after the re-organisation of the Defence Department.⁵³ The re-organisation of the various separate defence groups into a single department was essential for the future of joint operations, and implicitly the RMA.⁵⁴

The general theme of the White Paper was the defence of Australia. The policy paper indicated an independent view with regard to regional interests and an increase in self-reliance.⁵⁵ The emphasis on defence self-reliance has been attributed to a number of events including the British retreat East of the Suez and its entry into the European Union. The Guam Doctrine and the US 'defeat' in Indochina also sparked the change.⁵⁶ The prominence of self-reliance in Australia's defence posture is usually traced back to the 1976 White Paper.⁵⁷

The White Paper addressed industry and technology aspects of self-reliance including the requirements for industry support of both hardware and expendables such as munitions.⁵⁸ The paper stated that, 'our military technology should be compatible with, but not necessarily equal in technical advancement with, relevant weapon systems of larger allies'.⁵⁹ The paper made direct reference to access to US science and technology because of the US alliance⁶⁰ but also due to unique Australian environmental conditions.

⁵³ Tange proposed the re-organisation in a report issued in November 1973. Legislation relating to the organisational changes was passed in September 1975 and the main provisions implemented in February 1976. Commonwealth of Australia, Department of Defence, *Australian Defence*, AGPS, Canberra, 1976, p. 5. (Abbreviated to 1976 White Paper). For details on the re-organisation see Sir Arthur Tange, *Australian Defence—Report on the Reorganisation of the Defence Group of Departments*, Department of Defence, Canberra, November 1973.

⁵⁴ The philosophy to break down the single-service structures and mindset was essential for the development of joint operations that are a foundation of the current RMA.

⁵⁵ Statements were made regarding the limited prospects of operations in 'distant regions' signalling the decline of a forward defence posture. The White Paper specifically raised the question of operations in 'two theatres concurrently' as well as operations in Europe, Africa, the Middle East and North East Asia, 1976 White Paper, pp. 5–6.

⁵⁶ Alan Stephens, 'Australia's Policy Options—Beyond Defence of Australia', *Australian Security in a New Era: Reform or Revolution?*, Special Report No. 5, ADSC, Canberra, 1998, p. 112.

⁵⁷ For example, see ASP97, p. 29 and White, 'Is Defence Self-Reliance Still Realistic?', p. 57.

⁵⁸ 1976 White Paper, p. 10.

⁵⁹ This caveat becomes an essential feature of the development of high technology based capability and also, without explicitly stating, US compatibility. 1976 White Paper, p. 14.

⁶⁰ The White Paper put some emphasis on the character of the relationship. '[I]mportant practical advantages flow to Australia ... unique in comprehensiveness and quality—in intelligence, defence science and technology ... tactical doctrine and operational procedure and military exercising ... with high technology', 1976 White Paper, p. 11.

The requirement for indigenous science and technology was flagged.⁶¹ Additionally, guidance was given to the development of a scientific base for propulsion, microelectronics, materials, warheads, guidance and sensors, as well as smart weapon systems,⁶² including lasers.⁶³ The paper outlined a broad range of activities for defence science and technology, including a number of new fields of interest.

While the 1976 White Paper offered specific direction for research, other government reports were to have a significant impact on DSTO. The 1976 Coombes Royal Commission began the debate on the efficacy of government administration and amongst a raft of sub-issues, the question as to the role of government in science.⁶⁴ The Secretary for the Department of Defence submitted that for defence science to prosper, it, 'must be intimately connected' with the Department of Defence' and 'it requires *detailed day to day responsiveness to departmental business*'.⁶⁵

⁶¹ As an example, the maritime environment is quite different in the Southern hemisphere to that of the Northern hemisphere. As a result, sonobuoys used to detect submarines require quite different sensors. For elaboration on the structure of the ocean around Australia and the subsequent development of sonobuoy technology, refer to Wisdom, *A History of Defence Science*, p. 161.

⁶² 'Smart weapons' are guided weapons that rely on target designation using lasers for example. They may be powered or un-powered. 'Dumb bombs' are unguided weapons that are uncontrolled once released.

⁶³ 1976 White Paper, p. 49.

⁶⁴ The organisation of science in government was reviewed with both the departmental and statutory body models examined. H.C. Coombes, *Royal Commission on Australian Government Administration: Report*, AGPS, Canberra, 1976.

⁶⁵ Emphasis in original. Coombes, *Royal Commission on Australian Government Administration: Report*, p. 314. Importantly the Commission 'endorsed the importance of having scientific work done in an environment favourable to the appropriate "culture", where workers are stimulated to act in accordance with the traditional "ethos" of science', p. 316. While the environment was not prescribed, the Commission nevertheless recommended that the various laboratories of the recently formed DSTO 'should be incorporated into a statutory body reporting to the Minister for Defence', p. 26. Reducing the imposts of government bureaucracy were an element of the Coombes recommendation but the underlying issue was emphasised in the view that pure scientific research, by its very nature, is driven by curiosity. As such, this requires an environment of autonomy and flexibility. For a discussion on fundamental (or pure) research and applied research see paragraphs 10.2.7–1.2.13. The claim for autonomy was interpreted as a claim for scientific curiosity but the Commission did note that scientists 'should not be exempted from the need to justify their claims on community resources', pp. 311–13. Similar arguments were also accepted for customer driven applied research and technology.

The Fink Internal Review⁶⁶ and the Rees External Review⁶⁷ followed in 1980. These reviews raised issues of DSTO responsiveness to short term demands of the ADF compared to long-term aims. Poor external relationships and the requirement for more external interaction with Australian industry were also highlighted. The reviews indicated that the administrative effectiveness could be improved by streamlining operations,⁶⁸ but were in disagreement over the organisational placement of DSTO.⁶⁹ The external review concluded that while the work undertaken in DSTO was of high quality the level of the basic research levels was too low because it was 'too responsive to the short-term demands of the Armed Services'.⁷⁰ To redress this imbalance, proposals were put forward to transfer non-scientific and non-research tasks to the Services or industry.⁷¹ The external review also argued for increased industry

⁶⁶ The Internal Review examined the internal organisation of DSTO and the organisations responsiveness to the Defence Organisation including Defence industry. P.T. Fink, *Internal Review into Objectives and Procedures of the Defence Science and Technology Organisation*, AGPS, Canberra, October 1980, p. 105.

⁶⁷ The External Review was concerned with the quality of DSTO's work, whether the program objectives of DSTO were being met, the balance between basic and tactical problem-oriented research, the relationship of DSTO with industry and other outside organisations. See Rees, *Independent External Review of the Defence Science and Technology Organisation*, p. 3.

⁶⁸ The desire for increased performance of government organisations can be traced back to the Coombes Royal Commission. The External and Internal Reviews resulted in an efficiency audit of DSTO task cost management. The findings were critical of the task approval, costing and review process as well as the management information systems. The technical effectiveness of DSTO was not challenged. Monaghan, J.V., *Report of the Auditor-General on an Efficiency Audit—Defence Science and Technology Organisation: task cost management*, AGPS, Canberra, March 1986.

⁶⁹ The External Review sided with the Coombes Royal Commission and recommended that DSTO become a statutory body whilst the Internal Review indicated that DSTO fitted well into Defence. Rees, *Independent External Review of the Defence Science and Technology Organisation*, pp. 123–24 and Fink, *Internal Review into Objectives and Procedures of the Defence Science and Technology Organisation*, p. 95.

⁷⁰ Rees, *Independent External Review of the Defence Science and Technology Organisation*, p. 186.

⁷¹ Rees, *Independent External Review of the Defence Science and Technology Organisation*, pp. 151–52.

interaction including commercialisation and support of industry manufacturing.⁷² The internal review concluded that DSTO had integrated well into the Defence Department but, 'recognised a concurrent need for clearer and more authoritative policy guidance, for more definitive and longer-term planning'.⁷³

Further investigations and changes to DSTO and Defence were to follow. The re-organisation, resulting from the recommendations of the Tange Report, was subject to a review in 1982 by the Utz chaired Defence Review Committee.⁷⁴ This review recognised that Defence's 'basic organisational structure [was] sound' but increased 'strengthening of the joint process' was required. The Defence Review Committee was also tasked with examining thirteen recommendations from the DSTO reviews dealing with DSTO's organisational form and its relationship with the defence organisation. Utz proposed in an interim report, that the government accepted, that the establishment of a Minister and Department of Defence Support would improve scientific and industrial capabilities for defence.⁷⁵ The movement of DSTO and the defence factories from Defence into Defence Support in May 1982 caused concern particularly within DSTO. The Chief Defence Scientist (CDS) in a submission to the Defence Review Committee in July 1982 argued that the transfer would lead to an increased emphasis on DSTO support to industry rather than 'its force multiplier role' for the ADF itself.⁷⁶ The committee appeared puzzled that the move would diminish this role, but the issue does indicate the apparent difficulty in having direct ADF involvement while at the same time balancing industry pressures for greater involvement.

⁷² The government response to the Internal and External Reviews was to accept most of the 110 recommendations. See J.W. Utz, *The Higher Defence Organisation in Australia*, AGPS, Canberra, October 1982, p. 302. The government rejected some recommendations of the External Review, or simply noted them and no further action was taken. Recommendations to fall into this category include increased industry support and interactions. However, increased commercialisation of DSTO output was recommended (recommendation 39) with the caveat that it must be secondary to the Defence role of DSTO. Commonwealth of Australia, 'Government Response', *Independent External Review of the Defence Science and Technology Organisation*, Canberra: unpublished, undated.

⁷³ Fink, *Internal Review into Objectives and Procedures of the Defence Science and Technology Organisation*, p. 91.

⁷⁴ An interim report was released in May, and the final report was released in October 1982; J.W. Utz, *A Minister and Department of Defence Support—Interim Report of the Defence Review Committee*, Canberra, May 1982, and Utz, *The Higher Defence Organisation in Australia* respectively.

⁷⁵ Utz, *A Minister and Department of Defence Support—Interim Report of the Defence Review Committee*, p. 29.

⁷⁶ Utz, *The Higher Defence Organisation in Australia*, p. 203.

The salient points to draw from the reviews were the concerns regarding a balance between customer driven short-term activity versus the strategic research required for long-term objectives.⁷⁷ The scientific 'ethos' was perhaps incompatible with the shorter-term scales demanded by the services.⁷⁸ The recommendations regarding increased commercialisation and industry interaction were also notable.

1986 Dibb Review and 1987 Defence of Australia White Paper

The Dibb Review of Australia's Defence Capabilities was a turning point in defence strategic planning. The principle of self-reliance was confirmed in the 1987 White Paper.⁷⁹ The Dibb Review was produced in the context, 'that the existing Australian defence establishment was unwilling and unable to adjust to a "post-forward defence" posture.'⁸⁰ Dibb noted that the civilian Department of Defence and the ADF differed, 'on how strategic factors should inform judgements' on the force structure, and as a result, these differences created institutional difficulties in defence policy development.⁸¹ Essentially the civilian elements of Defence were planning for low-level contingencies whereas the ADF was more interested in the high-level, traditional war fighting.⁸² DSTO's research programs fundamentally supported traditional high-level conflicts requiring capabilities such as combat aircraft and guided weapons systems. The programs were not focused on low-level conflicts and non-traditional threats.⁸³

⁷⁷ The balance between basic or strategic research and tactical problem solving is also coincident with the balance between the freedom of scientific curiosity and customer responsiveness. Fink, *Internal Review into Objectives and Procedures of the Defence Science and Technology Organisation*, p. 94.

⁷⁸ The recommendations were a forewarning of the difficulties faced two decades later when internal issues as well as a myriad of external influences impact DSTO research programs. This is discussed further in Chapter 4. See Trevor Thomas, 'DSTO set to struggle on through shifting allegiances', *Australian Defence Business Review*, Vol. 19, No. 15, 20 October 2000, pp. 8,13.

⁷⁹ 1987 White Paper, p. vii.

⁸⁰ Michael O'Keefe, 'An Analysis of Australia's Defence Posture in relation to the Strategic recommendations of the Dibb Report', Politics Honours Thesis, La Trobe University, Melbourne, November 1993, p. 8.

⁸¹ Dibb Review, p. 6.

⁸² Dibb criticised the compartmentalisation of the advice given to government and he observed that the intent of the Tange Report was not to have a military and a non-military component. The lack of collaboration led to the recommendation for 'the centralisation of military operational requirements staffs within [HQADF]'. Dibb Review, pp. 28–29.

⁸³ A number of elements of DSTO research have application to low-level and non-traditional conflicts eg ESRL surveillance research is applicable to non-traditional threats such as the ability to detect illegal migration and drug traffickers. Within AMRL, the Combatant Protection and Nutrition Branch (CPNB) 'works to detect, identify and protect the ADF against current and emerging nuclear, biological and chemical (NBC) threats and to support the development of an ADF capability for operations in an NBC-contaminated environment.' <http://www.dsto.defence.gov.au/iDSTO/references>, accessed 11 December 2001.

With the lack of an identified threat and therefore threat scenario, Dibb found no rationale for the existing force structure elements and his report aimed to provide 'a basis and rationale for the structure of the [ADF]'.⁸⁴ In a similar vein, Dibb proposed that institutional change was required to facilitate joint planning.⁸⁵ He sought to restrict the potential for arguments on force structure needs. Rather he put the 'focus ... on those fundamental geographic and strategic factors, including current and prospective regional military capabilities'.⁸⁶ The Dibb Review argued for a 'strategy of denial' that was a defensive policy.⁸⁷

The Review propose[d] a layered strategy of defence within our area of direct military interest. Our most important defence planning concern is to ensure that an enemy would have substantial difficulty in crossing the air and sea gap.⁸⁸

The US alliance was accepted as a part of defence policy, particularly with regard to high-level conflict scenarios but the benefits were acknowledged with little grace.⁸⁹ Intelligence access, material acquisition and support, logistical support and technology access was accepted and 'the presence of joint facilities and political support' was seen as a reasonable *quid pro quo*.⁹⁰

In the 1987 White Paper, Beazley stated that, 'the strategy on which self-reliance is based establishes an extensive zone of direct military interest',⁹¹ thus attempting to deflect criticism that the policy was isolationist. While self-reliance was seen as 'defence in depth'. This was used to describe the ability to respond to a range of threats, defensively and offensively.⁹²

⁸⁴ Dibb Review, p. v.

⁸⁵ Dibb Review, p. 29.

⁸⁶ Dibb Review, p. vii.

⁸⁷ The Dibb Review was seen by many to have significant flaws. The flaws included optimistic threat assessments, self-reliance to the detriment of the alliance, and the strategy of denial was essentially viewed as a return to isolationism. See Alan Wrigley, *The Defence force and the Community: A Partnership in Australia's Defence*, Report to the Minister for Defence, AGPS, Canberra, June 1990, pp. 18–19. Other analyses challenging the Dibb Review's purported defensive stance include Andrew Mack, *Defence Versus Offence: The Dibb Report and its Critics*, Working Paper No. 14, Peace Research Centre, ANU, Canberra, September 1986.

⁸⁸ Dibb Review, p. 5.

⁸⁹ Dibb Review, pp. 4, 46.

⁹⁰ Dibb Review, pp. 4, 46.

⁹¹ 1987 White Paper, p. vii.

⁹² In the White Paper it was stated that '[s]elf reliance means defence in depth'. The strategy of defence in depth included a ready reserve element, 1987 White Paper, p. vii.

Dibb accepted the self-reliance concept, with caveats for those wishing to extrapolate the concept to self-sufficiency. This was reiterated in the White Paper along with the requirement to maintain a technological edge over regional forces. It was stated that:

Australia should favour advanced technology where it confers an operational advantage, reduces manpower or life-cycle cost, avoids early obsolescence or the need for additional equipment, simplifies operation and support, or where it is otherwise particularly suited to Australia's strategic circumstances.⁹³

The focus of Dibb's industry policy was on the support for 'credible contingencies' rather than continue with an industry focused on postwar industrial capability.⁹⁴ The postwar policy of import replacement especially using the wartime capacities changed in the 1970s when the low economic viabilities were realised. The issue of 'the desirability of designing and producing platforms and weapons in Australia' was raised and Dibb argued that these capabilities should only be cultivated in the rare case that there were unique Australian requirements.⁹⁵

While Dibb did not directly review DSTO capabilities, he argued that the increased use of technology required additional DSTO input. The White Paper noted that many current and future programs were contributing directly to increased self-reliance such as OTHR, sonar and mine hunter systems, all of which supported the defence of the sea and air gap.⁹⁶ The definition of self-reliance in this context appeared to indicate high technology for unique Australian requirements. The White Paper put forward a 'shopping list' of activities and indicated that there were opportunities for local industry. Additional support and transfer of technology from DSTO would be required.⁹⁷ Government had recognised that long term, fundamental

⁹³ 1987 White Paper, p. 69.

⁹⁴ Dibb Review, p. 109.

⁹⁵ Dibb Review, p. 110.

⁹⁶ 1987 White Paper, p. 84.

⁹⁷ During this period there was a desire to increase DSTO industry interaction and commercialisation of research. The Minister for Defence Science and Personnel announced in November 1987 that the scope of DSTO was to be broadened to include support, albeit at the lowest priority, to non-Defence areas if in the national interest. Commonwealth of Australia, Department of Defence, *Defence Report 1987–88*, AGPS, Canberra, 1988, p. 40; Dibb Review, p. 73.

research was decreasing due to pressures of short-term priorities. Short-term priorities usually result from requirements to support the 'force-in-being' and acquisition projects, rather than forward-looking indigenous capability developments.⁹⁸

There was a wide range of views as to the impact of the Dobb Review on subsequent White Papers. It has been argued that the 1987 White Paper simply 'translated Dobb's key recommendations into government policy.'⁹⁹ Others argue that the White Paper avoided Dobb's 'isolationism and the inventing of enemies'.¹⁰⁰ The evolution of the Dobb Review into Beazley's articulation of the defence policy of 'self-reliance under the framework of alliances' is reflected in Australia's engagement in distant areas such as the Gulf War in 1991,¹⁰¹ thus deflecting the isolationist argument.¹⁰²

The intensity of the defence debate of the time was primarily due to Beazley.¹⁰³ As Minister for Defence he instigated a number of defence reviews including industry, facilities and a review of community attitudes.¹⁰⁴

⁹⁸ Strategic planning is made difficult given the plethora of high priority tasks arising from unplanned operational requirements such as maritime rescues, aircraft accidents, equipment failures or terrorism. At times, short-term priorities such as the 'fixing' of the Collins-class submarine result from an ignorance of, or under-estimate of, science and technology requirements. For a related example see Malcolm McIntosh and John Prescott, *Report to the Minister for Defence on the Collins Class Submarine and Related Matters*, Canberra, June 1999, pp. 14–15.

⁹⁹ Stewart Woodman, 'Unravelling Australia's Strategic Dilemma', in Ian McLachlan, et al., *Australia's Strategic Dilemmas: Options for the Future*, ADSC/ADFA, Canberra, 1997, p. 16.

¹⁰⁰ Lim, 'Australian Security After the Cold War', p. 96.

¹⁰¹ It is acknowledged that Australia's input was small. The principal involvement consisted of two surface combatants and a supply vessel that were made available to the Multi-National Naval Force. Commonwealth of Australia, Department of Defence, *Defence Report 1990–91*, AGPS, Canberra, 1991, p. 7.

¹⁰² Lim, 'Australian Security After the Cold War', p. 96.

¹⁰³ An example of the breadth of his input see Beazley, K., 'Foreword', Desmond Ball and Cathy Downes, (eds), *Security and Defence: Pacific and Global Perspectives*, Allen and Unwin, Sydney, 1990.

¹⁰⁴ Cooksey was tasked with a number of reviews in the period, the relevant reviews were reported in Robert Cooksey, *Review of Australia's Defence Exports and Defence Industry*, AGPS, Canberra, October 1986 and Robert Cooksey, *Review of Australia's Defence Facilities*, AGPS, Canberra, December 1987. The Wrigley Review had a very broad brief and included discussions on capability, reserves schemes and a review of core activities. Wrigley, *The Defence Force and the Community: A Partnership in Australia's Defence*.

As the 1992 Price Report was later to state, 'in the 1987 White Paper, the federal government made a commitment to Australian industry that it would be relied upon to support, maintain and develop Australia's Defence Force'.¹⁰⁵ A key thrust of the Dibb influenced 1987 White Paper—the maintenance of the technology edge—has proved resilient.¹⁰⁶

The 1990 Wrigley Report¹⁰⁷ and the 1991 Force Structure Review¹⁰⁸ were carried out to 'apply the principles set out in the 1987 Defence White Paper' and therefore provide 'detailed measures for the practical implementation of self-reliance'.¹⁰⁹ The reports aimed to take into account strategic priority changes and resource constraints. Wrigley spent much time articulating how and why the defence program needed to understand community expectations and how to sell defence to the community. The report indicated that the community must be convinced that defence needs 'the full resources of the people and the national infrastructure' for the community 'to believe that Australia can be self-reliant'.¹¹⁰ No clear definition of self-reliance was offered and perhaps the expression that the community 'believe' rather than actually 'achieve' self-reliance was indicative of the difficulty in maintaining the defence capability—both in terms of force numbers and in the support required from industry. The recommendations of the Force Structure Review were the change of emphasis to the Reserves, 'greater efficiency in support and maintenance functions ... and some adjustments to the major capital investment program'.¹¹¹ The impact of the Force Structure Review was limited at the time but it can be seen to impact the move to search for greater

¹⁰⁵ Roger Price, *Defence Policy and Industry*, AGPS, Canberra, November 1992, p. i. It should be noted that two other papers contributed to the Price report: The Allen Consulting Group, *Defence and Australian Industry: Description and Economic Analysis*, AGPS, Canberra, October 1982; Paul Dibb, *The Strategic Priorities for Australian Defence Industry*, SDSC, ANU, Canberra, November 1992.

¹⁰⁶ The term has evolved from the technology edge to the information edge with little rigour in defining the concepts or usage. 2000 White Paper, p. 108.

¹⁰⁷ Wrigley, *The Defence Force and the Community: A Partnership in Australia's Defence*.

¹⁰⁸ The key elements of the *Force Structure Review* were the continuing shift to the north and west of the ADF, redirection of resources from support areas to the combat forces, increased use of commercial infrastructure and the reserve changes. The development of HMAS Stirling in Western Australia, the bare bone bases in the north of Australia, the Commercial Support Program, and the Ready Reserve Scheme were outcomes of the Review. A. Ayres and P. Gratton, *Force Structure Review*, AGPS, Canberra, May 1991.

¹⁰⁹ *Defence Report 1990–91*, p. 7.

¹¹⁰ Wrigley, *The Defence Force and the Community: A Partnership in Australia's Defence*, p. 482.

¹¹¹ The Reserve proposals were to form the basis of the ill-fated Ready Reserve scheme. The defence and public debate surrounding the 2000 White Paper bore some similarity to the reviews of the early 1990s. In both cases the public was being asked to articulate what type of defence force was required and how much the community was willing to commit to the task. A. Ayres and P. Gratton, *Force Structure Review*, p. iii.

industry involvement, both core and support activities. A decade later the Defence Efficiency Review was still grappling with similar issues. The reviews indicated that the principle of self-reliance, particularly the industry element as espoused under the Hawke government, was causing considerable trouble.¹¹²

The period around the Dibb Review was also significant for the various reviews into Australian research capabilities. The Hawke government was concerned with national issues such as Australia's place in the developed world given the decline in Australia's terms of trade, unemployment and the acceptance of self-reliance as part of the defence posture. Science and technology was seen as a basis for industrial capacity and growth. In May 1985 the Australian Science and Technology Council (ASTEC), conducted a review,¹¹³ that included a report on the relationship between DSTO and national objectives.¹¹⁴ The results of this review were positive for DSTO as it was seen as 'an efficient and well managed organisation, which contributes substantially to Australia's defence goals'. The recommendations of the report aimed to improve 'DSTO's role in defence policy making, and make its interactions with Australian industry more effective'.¹¹⁵ The Defence Annual Reports of the time also added credence to the role of DSTO in supporting the establishment of a 'self-reliant defence force', increased commercialisation and the alignment of research activities with defence priorities.¹¹⁶

¹¹² Cheeseman, *The Search for Self-Reliance*, p. 118.

¹¹³ ASTEC, *Public Investment in Research and Development in Australia*, AGPS, Canberra, 1985.

¹¹⁴ R. Slatyer, *The Defence Science and Technology Organisation and National Objectives: A Report to the Prime Minister by the Australian Science and Technology Council (ASTEC)*, AGPS, Canberra, 1986, p. ii.

¹¹⁵ Commonwealth of Australia, Department of Defence, *Defence Report 1986-87*, AGPS, Canberra, 1986-87, p. 75.

¹¹⁶ The priorities noted included intelligence and surveillance, command, control and communication, maritime protection and land force mobility and also increased basic research. *Defence Report 1987-88*, pp. 40-41.

As a follow-up to issues identified in the earlier ASTEC reviews the core capacity of Australia's science and technology was examined in the light of 'projected economic developments and [the ability] to meet national responsibilities.'¹¹⁷ In reference to DSTO, it was again found that Australian industry could benefit from increased commercialisation of DSTO output and it was proposed to 'redirect ... part of DSTO's research activities to assist [local defence industry] development'.¹¹⁸

The 1987 White Paper and the Force Structure Review had a strong influence on government. DSTO responded by articulating its alignment with defence priorities¹¹⁹ and by seeking efficiency gains through a reduction in support activities.¹²⁰ In response to the ASTEC reviews, DSTO put in place mechanisms for increased commercialisation. For example, an Industry Support Office was established at the Aeronautical Research Laboratory (ARL) in November 1992 to provide improved mechanisms for technology transfer.¹²¹

¹¹⁷ R.L. Martin, *The Core Capacity of Australian Science and Technology*, ASTEC, AGPS, Canberra, March 1989, p. iii. Later in 1989, Martin investigated the current state, and potential benefit, of basic scientific research. R. L. Martin, *Profile of Australian Science*, ASTEC, AGPS, Canberra, 1989.

¹¹⁸ Martin, *The Core Capacity of Australian Science and Technology*, p. 35.

¹¹⁹ In the early 1990s, evidence of the alignment of DSTO with Defence priorities increased. The advisory committee to the Chief Defence Scientist annually reviewed the various Laboratories, and the criteria of success were the 'alignment [of the Laboratories] with Defence priorities and objectives', from *Defence Report 1990–1991*, p. 133. In 1992, the criteria also included 'the responsiveness of the Program to identified strategic priorities such as those detailed in the 1987 White Paper and the Force Structure Review', from Commonwealth of Australia, Department of Defence, *Defence Report 1991–1992*, AGPS, Canberra, 1992, p. 133.

¹²⁰ As a result of the Force Structure Review, DSTO had a target of 700 staff reductions. Commonwealth of Australia, Department of Defence, *Defence Annual Report 1994–1995*, AGPS, Canberra, 1995, p. 181.

¹²¹ Commonwealth of Australia, Department of Defence, *Defence Report 1992–93*, AGPS, Canberra, 1993, p.151.

1993 Strategic Review and 1994 Defending Australia White Paper

The 1993 Strategic Review was released as a 'part of a continuous cycle of defence planning' and provided the basis for the 1994 White Paper.¹²² The gap between White Papers was notable.¹²³ The strategic outlook in this paper was more pessimistic than in the previous White Paper due to the increasing complexity and uncertainty in the region, as well as the falling resource levels. The White Paper was criticised for putting forward a realist view of security because of the narrow view of Australia's interests and the lamenting of the loss of the stability imposed by the Cold War.¹²⁴ The White Paper generally reflected a move toward regional engagement while fundamentally still being based on the defence of Australia. The concept of self-reliance was reiterated as 'remaining essential' and it was noted that 'the development of our economy and technological skills has made self-reliance more achievable'.¹²⁵ In discussions on the US alliance, the practical benefits to the ADF included 'access to the highest levels of exportable weapons and technology' and defence science links 'support our access to high technology through partnerships in developing high technologies applicable to our strategic environment'.¹²⁶ The concept of defence self-reliance with an alliance framework was reconfirmed.

¹²² The Strategic Review had a stated timeframe of 3–5 years, whereas the White Paper looked forward up to fifteen or twenty years. See the 1994 White Paper, p. iii; Commonwealth of Australia, Department of Defence, *Strategic Review 1993*, Defence Publications, Canberra, December 1993, p. iii.

¹²³ The release of the White Paper was welcomed by the defence community and it was generally well received but as expected critical debate was generated amongst analysts. Jenny Bonnor and Gary Brown, (eds), *Security for the Twenty-First Century?*, Australian Defence Studies Centre, ADFA, Canberra, 1995, p. 1. The discussion generated was somewhat orchestrated with senior service personnel adding their imprimatur to the paper, see Walls, 'Defending Australia—The 1994 Defence White Paper', pp. 1–14, and then the critiques organised by the academia. See Jenny Bonnor and Gary Brown, (eds), *Security for the Twenty-First Century?*

¹²⁴ During the gap between White Papers, the Cold War ended. The Cold War had occupied the minds and actions of the world's strategic planners for nearly five decades. As O'Neil observed 'since the end of the Cold War ... states by and large still adhere to the Clausewitzian-derived maxim that military force constitutes a viable option for pursuing political objectives when national interests are threatened', Andrew O'Neil, 'The Regional Security Implications of the East Asian Crisis: The Challenge of Uneven Development', *Policy, Organisation and Society*, Vol. 18, 1999, p. 2. There has been much debate as to the efficacy of stability when living under the threat of Armageddon. On this see the 1994 White Paper, p. 8.

¹²⁵ 1994 White Paper, pp. 13–14.

¹²⁶ 1994 White Paper, 1994, p. 97.

The White Paper devoted separate chapters to industry and science and technology. The defence industry was seen as being essential, but in order for it to survive it must develop export markets. In a report on the efficacy of the expansion of the defence industry, Markowski noted, without the economies of scale available to Australia, and no mention of a cost premium incurred in support of local industry, this was all but 'wishful thinking'.¹²⁷ Traditional defence industries supported the argument that Australian industry was increasingly competitive internationally, nevertheless 'a degree of clear preference' should be given to 'Australian' firms.¹²⁸ The White Paper referred to the 1992 Price Report on the defence industry¹²⁹ and it was interpreted that, 'supporting Australian defence industry was not a defence objective in its own right'¹³⁰ and thus there was an expectation that the industry must develop alternative markets to augment Australian public procurement.¹³¹

The defence industry had declined in terms of indigenous projects but the White Paper did note that development was still possible in limited circumstances.¹³²

Our dependence on a small, technology-based, mobile and integrated force requires us to keep abreast and in some cases lead developments in some areas of defence technology, including software development and systems integration.¹³³

¹²⁷ Stefan Markowski, 'National Defence Support and Defence Industry', in Jenny Bonnor and Gary Brown, (eds), *Security for the Twenty-First Century?*, p. 214.

¹²⁸ The argument as to what constitutes Australian industry is secondary. However, Harris argues that '[d]efence policy needs to recognise that nationally owned or centred companies have a special strategic place in the nation.' Ken Harris, 'An Industry Perspective', in Jenny Bonnor and Gary Brown, (eds), *Security for the Twenty-First Century?* p. 205.

¹²⁹ Price, *Defence Policy and Industry*.

¹³⁰ 1994 White Paper, p. 116.

¹³¹ Using examples from the aircraft industry, Smith shows the cyclical nature of the public procurement process. Peter Smith, 'Australia's Aerospace Industry and Defence' in Frank Cain, (ed.), *Arming the Nation: a history of defence science and technology in Australia*, Australian Defence Studies Centre, ADFA, Canberra, 1999, pp. 63, 66–74.

¹³² The decline is in comparison to the post war period where, for example, the aircraft industry developed a number of indigenous projects that in retrospect were neither commercial successes nor the basis for long-term ADF support. The value of the platforms was shifting to that of the system components rather than the platform itself.

¹³³ 1994 White Paper, p. 115.

The common theme in the paper, in terms of industry capability, was for combat systems software, data management and signal processing, command, control and communications systems and systems integration. Traditional 'metal bashing' or 'screw-driver' assembly was no longer an objective of the industry. The increased service life of platforms meant fewer platform acquisition programs but due to the increasingly complex onboard systems these would be upgraded a number of times during the platform lifetime.¹³⁴

While the role of industry in self-reliance was supported, there was argument as to the utility of a local industry that did not produce smart weapons when it was envisaged that in most conflicts these would be employed and quickly expended. Australia would then be dependent on the US for re-supply. The validity in proposing a larger defence industry, particularly for limited production of equipment such as submarines and frigates, with cost premiums for local production appears flawed.¹³⁵ This position results from the looseness attributed to the self-reliance concept when prioritising and evaluating industry projects.

The Science and Technology chapter of the White Paper stated that the four broad objectives of DSTO were:

- Exploit promising technologies
- Informed buyer of equipment
- Develop new capabilities as required
- Supporting existing capabilities¹³⁶

¹³⁴ As an example, the P-3C was first delivered to the RAAF in 1968 and since this time the airframe has not fundamentally changed. However the weapons and anti-submarine warfare systems are being upgraded three times. Neville Parnell and Trevor Boughton, *Flypast, a record of aviation in Australia*, AGPS, Canberra, 1988, p. 315.

¹³⁵ Gary Brown, 'DA94: Weaknesses and Revealing Contradictions', in Jenny Bonnor and Gary Brown, (eds), *Security for the Twenty-First Century?* pp. 111–12.

¹³⁶ The Chief Defence Scientist of the time, Dr Brabin-Smith noted 'the prominent position that the White Paper gives to technology; something I find entirely appropriate'. Richard Brabin-Smith, 'The 1994 White Paper: Science and Technology Aspects', in Jenny Bonnor and Gary Brown, (eds), *Security for the Twenty-First Century?*, p. 214.

The difficulties encountered by the defence organisation in assigning priorities to science and technology were highlighted.¹³⁷ Priorities for research and development were assigned and these were linked directly to the planned capability developments.¹³⁸ The White Paper nominated a number of disciplines common to a range of capability development priorities. This was used to guide DSTO research programs.¹³⁹ The specific direction is notable because it was the first time that a White Paper had prescribed technology fields in relation to broader capability objectives.

The White Paper noted the declining defence budget and the pressure to make the department more efficient led to a 'top-down' review. The 1996 Defence Efficiency Review (DER)¹⁴⁰ examined key management processes and made recommendations for reform.¹⁴¹ The recommendations were claimed

¹³⁷ 1994 White Paper, p. 125.

¹³⁸ The defence capabilities noted were: Command, Control and Communications; Surveillance of Maritime areas and Northern Australia; Maritime Operations; Air Defence in Maritime areas and Northern Australia; Land Operations; Strategic Strike; Support of the Force From 1994 White Paper, pp. 37–55.

¹³⁹ Research fields identified include support for intelligence, surveillance, electronic warfare, communications, information technology and exploitation of environmental information, (acoustics and electromagnetic propagation), signature management, operational research, combat modelling and simulation and advanced materials. For more information see 1994 White Paper, pp. 125–26.

¹⁴⁰ The Minister for Defence, Ian McLachlan established the review chaired by Malcolm McIntosh. The review was wide ranging and investigated the continuation of the civilian/military diarchy under the Minister for Defence through to a merger of the three services. Malcolm McIntosh, *Future Directions for the Management of Australia's Defence: Report of the Defence Efficiency Review*, Defence Publishing and Visual Communications, Canberra, March 1997, p. 1.

¹⁴¹ The DER also assessed the effectiveness and efficiency of management and financial processes. Two reports were issued in March 1997, *Future Directions for the Management of Australia's Defence—Report of the Defence Efficiency Review* and details of the review of each of the Defence Organisations in Malcolm McIntosh, *Future Directions for the Management of Australia's Defence—Addendum to the Report of the Defence Efficiency Review; Secretariat Papers*, Defence Publishing and Visual Communications, Canberra, March 1997. The recommendations of the Defence Efficiency Review led to the Defence Reform Program. The key principle of the program was that the Defence organisation had to be 'structured for war and adapted for peace'. The Defence Department was realigned and expanded into twelve organisations; Defence Headquarters, Navy, Army, Air Force, Intelligence, Acquisition, Science and Technology, Logistics, Defence Estate, Personnel, Education and Training and Administration. McIntosh, *Future Directions for the Management of Australia's Defence: Report of the Defence Efficiency Review*, p. E–3. The previous Defence Organisation consisted of eight programs, for detail see Commonwealth of Australia, *The Defence Organisation—A Short Guide for Industry*, 2nd edn, Directorate of Publishing, Canberra, June 1995.

to enhance the policy goals of 'developing greater self-reliance, promoting closer alliance relations and promoting regional engagement'.¹⁴² To overcome a lack of Australian industry involvement in the developmental stages of defence equipment programs, the concept of indigenous capability and technology demonstrators (CTD) was raised. The push for CTDs was questionable as these 'one-off' projects faced a high likelihood of failure due to the lack of substantial experience in developing new capabilities.¹⁴³ Specific 'requirements studies and development projects were envisaged with input from the Defence Acquisition Organisation, HQADF's Capability Development and DSTO'.¹⁴⁴

In the area of capability development, 'concern ... with the effectiveness of the processes by which capability is planned and acquired' was expressed.¹⁴⁵ A requirement to improve technical analyses was noted and this led to a recommendation that 'DSTO develop further its advanced systems modelling capability'.¹⁴⁶ The review of DSTO was generally seen as very favourable and improved customer satisfaction with DSTO was noted.¹⁴⁷ The three Service's Research and Development Requirements Committees set research priorities¹⁴⁸ and this approach was judged as working well.¹⁴⁹ Short-term customer focused research compared to the long-term strategic research was raised but the main concern was a lack of progress in industry interaction.

¹⁴² McIntosh, *Future Directions for the Management of Australia's Defence: Report of the Defence Efficiency Review*, p. 1.

¹⁴³ The scenario is a 'chicken and egg' one in that the industry argued that it needed involvement in a number of programs before it could build the experience levels required to improve the success rate of projects.

¹⁴⁴ Concerns were raised regarding the potential for compromise because DSTO generated projects and it also had a role as an independent arbitrator. McIntosh, *Future Directions for the Management of Australia's Defence: Report of the Defence Efficiency Review*, p. 36.

¹⁴⁵ McIntosh, *Future Directions for the Management of Australia's Defence: Report of the Defence Efficiency Review*, pp. 22–23.

¹⁴⁶ McIntosh, *Future Directions for the Management of Australia's Defence: Report of the Defence Efficiency Review*, p. 39.

¹⁴⁷ The relationship between the defence customer and the provider was under scrutiny. The 'user pays' concept was raised in the DER but rejected in the case of DSTO because of the small economies of scale and the view that DSTO was not simply a provider to Defence but it was 'a key component of the Defence Organisation'. McIntosh, *Future Directions for the Management of Australia's Defence: Report of the Defence Efficiency Review*, p. 39.

¹⁴⁸ The priorities were set within Force Research Areas. These are aligned with the various Force Element Groups. Using the Air Force as an example, these groups correspond to assets e.g. Maritime, Fighter, Strike under the command of a 'one star', e.g. Air Commodore.

¹⁴⁹ McIntosh, *Future Directions for the Management of Australia's Defence: Addendum to the Report of the Defence Efficiency Review Secretariat Papers*, p. 326. However, duplication between the various service test and evaluation areas was noted and it was recommended that along with rationalisation, the functions should be placed in the Science and Technology Program.

McIntosh, *Future Directions for the Management of Australia's Defence: Report of the Defence Efficiency Review*, p. E–6.

In summary, the period around the 1994 White Paper was characterised by support for the notion of self-reliance under an alliance framework with an increasing regional outlook. The technology edge was still espoused and as a result increasing guidance was given to DSTO to conduct research into various technologies and advanced systems modelling capability, as well as the ubiquitous calls for increased interaction with industry.¹⁵⁰

1997 Australia's Strategic Policy

The Foreign Affairs White Paper, *In the National Interest*,¹⁵¹ was released in 1997, followed five months later by Defence's, *Australia's Strategic Policy*.¹⁵² These two papers¹⁵³ were 'developed in close coordination' and the strategic policy in the defence paper could be 'seen as implementing key aspects of the [Foreign Affairs and Trade] White Paper's conclusions'.¹⁵⁴

The core force structure priority was the defence of Australia, and with this, the requirement for maximising self-reliance.¹⁵⁵ The next two priorities were seen as defending Australia's regional interests and then supporting Australia's global interests. The national capabilities required for the support of the ADF were to be made on 'a strictly commercial basis' and this was seen as a way of 'cultivating the efficiency of [the] national support base'.¹⁵⁶ The move to commercial suppliers for defence services and equipment elicited the statement that industry that worked only for defence would be 'as small as possible'.¹⁵⁷

¹⁵⁰ Commonwealth of Australia, *The Defence Organisation—A Short Guide for Industry*, Chapter 1, p.2, Chapter 3, p.1.

¹⁵¹ Commonwealth of Australia, *In The National Interest*, Department of Foreign Affairs and Trade, Canberra, 1997.

¹⁵² Commonwealth of Australia, *Australia's Strategic Policy*, Defence Publishing and Visual Communications, Canberra, December 1997.

¹⁵³ The strategic policy papers articulated Australia's principal strategic interests as the Asia-Pacific region, but due to the timing, the changes to the regional security environment due to the October financial crisis in Asia were not discussed. As the impact of the financial crisis was not known at the time, the growth in military capability in the region was noted as reflecting the growing defence expenditures reflecting growing economies. With the exception of Indonesia, most of the Asian nations have substantially recovered from the crisis, and therefore in a strategic sense this was arguably a mere aberration. For a discussion of how the crisis affected regional security, see Desmond Ball, *Implications of the East Asian Economic Recession for Regional Security Cooperation*, SDSC, ANU, Canberra, January 1999.

¹⁵⁴ ASP97, p. 3.

¹⁵⁵ ASP97, p. 29.

¹⁵⁶ ASP97, p. 49.

¹⁵⁷ ASP97, p. 49.

The 'RMA or the information revolution' and the 'knowledge edge' were introduced into the policy arena for the first time, but with little explanation.¹⁵⁸ The knowledge edge can be viewed as a component of the RMA. It is significant that the RMA was interpreted quite narrowly and simply as the information revolution. The commonality between civil and defence sector industries was noted, but the implications of applying civil technology into the defence environment were ignored. No explicit mention was made of defence science but it was implicit in the sections on the support to national industry and the knowledge edge. DSTO noted the impact of ASP97 by the 'evolution of its work program' to satisfy Defence priorities.¹⁵⁹

Further industry developments occurred with the 1998 release of a Strategic Policy Statement that expanded the CTD Program to provide greater scope for industry-initiated proposals.¹⁶⁰ Also increased was DSTO and industry interaction with the aim of creating industry partnerships and specifically defence industry self-reliance.¹⁶¹ Given the claim that 'DSTO has a clear focus on supporting Defence's capability priorities' the increased alignment of industry with DSTO was claimed to increase industry's chance of meeting defence needs.¹⁶² There is little evidence to suggest any major increase in indigenous industry.¹⁶³

¹⁵⁸ The information revolution was seen as 'the effective exploitation of information technologies to allow us to use our relatively small force to maximum effectiveness'. ASP97, pp. 55–56. These simplistic interpretations, or definitions, of the RMA are addressed in Chapter 3.

¹⁵⁹ DSTO indicated in the Defence Annual Report the influence of the ASP97 in the Defence Annual Report as well as the Army's A21 Review. Commonwealth of Australia, Department of Defence, *Defence Annual Report 1997–1998*, Defence Publishing Service, Canberra, 1998, p. 259. The Army in the 21st Century Review, (abbreviated to A21 Review) was conducted to provide 'a rigorous analytical basis for defining an appropriate force structure. Commonwealth of Australia, Department of Defence, *Restructuring the Australian Army*, Directorate of Publishing and Visual Communications, Canberra, February 1997.

2000 White Paper

In June 2000, a public discussion paper was released as a precursor to the 2000 White Paper.¹⁶⁴ The paper raised a number of questions relating to force structure, ADF tasks, capability and budget and the public debate captured the attention of a number of commentators in the press¹⁶⁵ perhaps due to the operations in East Timor but also for reasons of defence self-interest,¹⁶⁶ such as industry.¹⁶⁷ The paper ignored any direct reference to Australian science and technology but references to the loss of the technological edge were made.¹⁶⁸

In December, the White Paper entitled, *Defence Review 2000—Our Future Defence Force* was released with a return to the defence of Australia posture.¹⁶⁹ Again the strategy of self-reliance was reiterated within an alliance framework, both the US alliance and regional relationships.¹⁷⁰ The White Paper focused on capability replacement programs over a ten year time frame reflecting the issues raised in the public discussion process as well as the tacit government approval for increasing the defence budget.¹⁷¹

¹⁶⁰ Commonwealth of Australia, Department of Defence, *The Defence and Industry: Strategic Policy Statement*, Defence Publishing and Visual Communications, Canberra, June 1998, p. 18.

¹⁶¹ The CTD program was quite specific about exploring new technologies for meeting defence capability deficiencies in areas of high priority. *Australian Defence Business Review*, Vol. 10, No. 13, 9 July 2001, p. 13.

¹⁶² The mechanism for doing this appeared to be based primarily on DSTO publishing more detailed information on future research programs. The underlying assumption is that DSTO not only currently accurately targets Defence priorities but also future ones. *The Defence and Industry: Strategic Policy Statement*, p. 18.

¹⁶³ The CTD program is still in its infancy. Funding for the program commenced in July 1998, and since then 13 demonstration projects have commenced. A mixture of Small to Medium Enterprises and multinational corporations are now involved. The majority of programs have been put forward with DSTO involvement. *Australian Defence Business Review*, Vol. 10, No. 13, 9 July 2001, pp. 12–13. For elaboration on the CTD program, see <http://www.dmo.defence.gov.au/id/ctd/ctd.cfm>

¹⁶⁴ Commonwealth of Australia, *Defence Review 2000—Our Future Defence Force: A Public Discussion Paper*, Defence Publishing Service, Canberra, June 2000.

¹⁶⁵ A number of national media publications such as the *Australian* and the *Bulletin* were involved in the debate. The public meetings generated significant interest but also a number of cynical responses on the media's part. For example, 'the retired admiral who lamented today's emphasis on air defence', David Nason, *Australian*, 10 August 2000, p. 2. The Australian Defence Studies Centre carried out a critical review of the Community Consultative Team report and process. The review researchers from ADSC were critical of the lack of sustained and constructive debate. See Trevor Thomas, 'CCT report a "hoax" says two Canberra academics', *Australian Defence Business Review*, 24 November 2000, p. 8.

¹⁶⁶ Analysts such as Dobb and Cheeseman have often criticised the closed shop, or self-interest, aspects of Defence. Perhaps this mindset is reinforced in the opening page of the 1997 Defence Efficiency Review secretariat papers, where the authors state, '[a]s expected, most innovative and concrete proposals have come from individuals and groups within Defence, although valuable input was also received from industry and other partners', McIntosh, *Future Directions for the Management of Australia's Defence: Addendum to the Report of the Defence Efficiency Review—Secretariat Papers*, p. 1.

References to defence science and technology related primarily to a move into RMA activities.¹⁷² Traditional activities, such as the upgrading and through-life support of existing platforms were briefly mentioned but the emphasis was undoubtedly on information technology. The White Paper articulated the need for a 'defence industry' by again including calls for the increased interaction with DSTO. The notion of self-sufficiency was raised and dismissed, whereas the requirement to support wartime operations was emphasised. The replenishment of smart weapons, integral to modern warfare was raised but seen as a stockpiling issue rather than justification for a move to local production. The CDS noted that the White Paper 'also sets out a major task for [DSTO] in supporting industry while maintaining [the] ability to provide independent advice to Government'.¹⁷³

Summary

Australia's security position has evolved from the days of Imperial defence, through to 'forward defence' and into the reassertion of the primacy of the defence of Australia in the 1990s. The current policy still articulates self-reliance within an alliance framework. A number of features of the Dibb Review translated into policy in the 1987 White Paper, endure—increased self-reliance and the 'knowledge edge'. Defence science has become increasingly integrated into defence policy and planning. In the region, Australia's technology edge has reduced and as the 2000 White Paper notes, in a number of capability areas, it has disappeared. The nexus between science and

¹⁶⁷ Robert Gottliebsen in the *Australian* makes the statement that 'if we lose our defence industry, we will have no independent defence'. The loose use of 'independence' compared with perhaps intended self-reliance is a further indication of the poor media, and probable public understanding of the notion of self-reliance. See, *Australian*, 22 June 2000.

¹⁶⁸ For example, '[s]ome combat aircraft in Asia are better than our F/A-18s' from *Defence Review 2000—Our Future Defence Force: A Public Discussion Paper*, p. 14.

¹⁶⁹ The paper was released some six months after the discussion paper on the 6th of December 2000 and was entitled *Defence Review 2000—Our Future Defence Force*.

¹⁷⁰ 2000 White Paper, pp. 39, 46–47.

¹⁷¹ The budget was under pressure because of the large number of major platform acquisitions planned for the next decade. Block obsolescence was a much-used term to describe the coming together of a number of high cost acquisitions such as F-18 and F-111, frigate replacements, air defence destroyers.

¹⁷² It was stated in the White Paper that there was 'widespread agreement that Australia should maintain the knowledge edge in intelligence, surveillance and reconnaissance capabilities', 2000 White Paper, p. 107.

¹⁷³ Ian Chessell, 'Defence White Paper presents opportunities and responsibilities for DSTO', *DSTO Connections*, 45, January–February 2001, p. 3.

technology and self-reliance has increased with the policy of the technology and information edge. The Dobb Review developed a framework for the development of defence industry in which the emphasis was on support to credible contingencies rather than the design and production of platforms. Government policy has continued to push for increased industry participation in defence activities and these included strategies such as the commercialisation of DSTO research.

CHAPTER 3 THE CONCEPT OF SELF-RELIANCE

Self-reliance is defined as independence or reliance on one's self.¹⁷⁴ The term is widely, and loosely, used in defence literature and has evolved into a principle upon which approaches to Australian Defence Force tasks are shaped.¹⁷⁵ At the strategic level, self-reliance means Australia must be able to defend itself 'without relying on the combat forces of other countries' It is also interpreted to cover various activities that enable an independent posture such as an indigenous intelligence capability and defence industry.¹⁷⁶ DSTO supports a range of these ADF activities and its involvement is justified on the basis of its contribution to self-reliance.

Self-reliance has been a part of Australia's defence strategy since the end of the Vietnam War.¹⁷⁷ At this time an assessment of the strategic environment indicated that an independent defence posture was required and the 1976 White Paper proposed an increase in self-reliance.¹⁷⁸ In the 1987 White Paper it was stated that in developing a self-reliant defence posture, priority should be given to developing capabilities that are required for the 'defence of Australia and its direct interests'.¹⁷⁹ The level of conflict expected was limited to low to medium-level contingencies. This was a significant refinement of defence strategy. The 1994 White Paper stated that, 'the foundation of the Government's defence policy is self-reliance' and the 'defence of Australia' role should dictate the defence force priorities.¹⁸⁰ The 1997 Strategic Assessment noted the importance of 'maximising our self-reliant ability to defeat attacks against Australia'.¹⁸¹ By the 2000 White Paper, self-reliance was one of three principles used to shape the approach in meeting the ADF's primary task, the defence of Australia.¹⁸²

¹⁷⁴ Macquarie Dictionary, 2nd edn, Macquarie University, 1991, p.1593.

¹⁷⁵ 2000 White Paper, p. xi.

¹⁷⁶ 2000 White Paper, p. xi.

¹⁷⁷ The Defence of Australia, 1987, p. 2. Wrigley noted that "'self-reliance" was already and emerging theme even before the Whitlam Government'. He refers to a parliamentary speech in March of 1972 in which the Mr Fairbairn, Minister for Defence, notes a duality of requirements where on one hand 'an increasing measure of self reliance' and on the other hand an 'intensification' of the alliance. Wrigley, *The Defence force and the Community: A Partnership in Australia's Defence*, p. 583.

¹⁷⁸ 1976 White Paper, p. 10.

¹⁷⁹ 1987 White Paper, p. 2.

¹⁸⁰ 1994 White Paper, pp. 13–14.

¹⁸¹ ASP97, pp. 29–30.

¹⁸² 2000 White Paper, p. xi.

The concept of independence is simple but the notion of self-reliance has become all encompassing and the breadth of the application of the self-reliance principle results in most, if not all, Australian defence activities coming under its mantle. This devalues the principle of self-reliance as priorities and orders of merit need to be established between various defence activities including industry and science.

Self-Reliance

During the mid 1980s considerable intellectual effort was put into developing a framework upon which defence policy would be formulated. As a result there was much written about self-reliance and the intent of such a posture. Beazley's preface to the 1987 White Paper stated:

The first aim of defence self-reliance is to give Australia the military capability to prevent an aggressor attacking us successfully in our sea and air approaches, gaining a foothold on any part of our territory, or extracting concessions from Australia through the use or threat of military force.¹⁸³

In 1986 Dibb prioritised the capabilities required for a self-reliant defence posture:

those ... capabilities which are needed for the defence of Australia and its direct interests. This requires a force-in-being to defeat any challenge to our sovereignty and specific capabilities designed to respond effectively to attacks within our area of direct military interest.¹⁸⁴

The 'defence of Australia' may involve a wide range of levels of conflict. Dibb argued that the likely tasks for the ADF were low-medium level conflicts and as a result self-reliance should be limited to these scenarios. This restriction was significant at the time and in this monograph it is referred to as 'limited' self-reliance. The alliance with the US¹⁸⁵ while based on the principles of

¹⁸³ 1987 White Paper, p. vii.

¹⁸⁴ Dibb Review, p. 2.

¹⁸⁵ The alliance with the US was developed in the climate of the defeat of Japan and fortuitously ANZUS was still plausible in the Cold War environment where nuclear conflict was not beyond comprehension. ANZUS is most relevant when looking at this high-level threat. For a discussion on low, medium and high-level threats see Coral Bell, 'The ANZUS Alliance: The Case For', pp. 221–31.

'self-help and mutual aid',¹⁸⁶ provides the security against a large-scale attack on Australia.¹⁸⁷ A 'limited' notion of self-reliance was articulated in the 2000 White Paper¹⁸⁸ when it was stated that the one important exception to the principle of self-reliance is that, 'Australia relies on the extended deterrence provided by US nuclear forces to deter the remote possibility of any nuclear attack on Australia.'¹⁸⁹

In examining the role of science and technology in supporting the principle of self-reliance, Beazley stated that:

What we seek from our allies—in peace and, if necessary, in conflict—is intelligence, technology, resupply and training. Taken together, this contribution gives Australia the technological edge... Without that help, Australia cannot sustain a self-reliant defence posture. In this fundamental way, our alliance is literally essential to our self-reliance.¹⁹⁰

Self-reliance with this caveat of alliance support may be considered an oxymoron but for a middlepower such as Australia, it is both a sensible and essential element of defence policy.

For the purposes of this monograph, the aim of self-reliance is limited to operations in low to medium-level conflict without relying on external help, but again in the Australian context there is an underlying and inextricable link to the 'shadow' of the alliance. A more detailed examination of the various

¹⁸⁶ Peter Reith, 'Address to ANZUS Conference'.

¹⁸⁷ The actual security guarantee afforded by ANZUS is difficult to judge. In the 1972 White Paper, the Coalition government of the time noted that the 'Treaty is generally accepted to be the assured foundation of Australia's ultimate security', 1972 White Paper, p. 15. As the Treaty has evolved and matured there has been no expectation of an ironclad guarantee. For further discussion on ANZUS security guarantees refer to Gary Brown, 'The ANZUS Alliance: The Case Against', pp. 232–36.

¹⁸⁸ Dibb considered that basic self-reliance is the minimum a country can contribute to an alliance, yet he did not dwell on the relationship between self-reliance and the alliance. Defence strategic policy academics generally accept that for Australian self-reliance the support offered by the US, our major ally, could not be excluded. Dibb in fact noted that with the Treaty '[t]here are no security guarantees', Dibb Review, p. 46. For elaboration on the alliance and self-reliance see Cheeseman, *The Search for Self-Reliance*, pp. xix, 172–200.

¹⁸⁹ 2000 White Paper, p. 36.

¹⁹⁰ Kim Beazley, 'Australia and the Asia Pacific Region: A Strategy of Self-Reliance and Alliance', address to the Asia Society, Washington, 30 June 1988, *Selected Speeches 1985–1989 by the Hon Kim C. Beazley, MP, Minister for Defence*, Directorate of Departmental Publications, Canberra, February 1989, p. 233.

elements that contribute to a self-reliance posture will now be made. As the principle of self-reliance was developed, Beazley stated that self-reliance was based on two pillars. The first pillar is the 'clear definition of our primary strategic environment which in turn dictates a force structure matching our unique geographic circumstances'.¹⁹¹

The second pillar is 'a competitive, technologically proficient and adaptable industry base, able to supply and support the ... [ADF]'.¹⁹² A cursory examination of the relationship between industry and self-reliance would indicate a strong interdependence but in the Dibb Review it was argued that self-reliance's 'applicability to industry is limited to the extent to which indigenous industrial capacity is necessary for the effectiveness and sustainability in combat of our forces'.¹⁹³ It is useful to examine the various industry sectors, both civil and defence against the aim of self-reliance. While many elements of industry and science and technology, for example, shipbuilding and basic research into materials, may contribute to the broad defence infrastructure they do not remain essential to the notion of limited self-reliance. Logistical support to sustain low to medium-level operations, including the manufacture of consumable weapons, would be fundamental in Dibb's limited view of self-reliance. Industry, and by inference, defence science, should be focused on the 'effectiveness and sustainability in combat of our forces'.¹⁹⁴

¹⁹¹ DSTO has a role here in developing analytical models to test various force structures. The theatre-level studies of Australian joint and combined defence operations are conducted in the Theatre Operations Branch. The scope of theatre-level studies includes surveillance, combat, logistics, information and command aspects of joint operations across environments and technologies. The principal clients for theatre-level studies are Headquarters Australian Theatre and Australian Defence Headquarters, Strategic Policy & Plans Division. <http://www.dsto.defence.gov.au/esrl/dsad/tob.html> , accessed 3 December 2001.

¹⁹² See Graeme Cheeseman, 'Introduction: Establishing the "Second Pillar" of Australia's Defence', in Graeme Cheeseman, (ed.), *Fostering Indigenous Defence Industry*, ADSC, Canberra, 1994, pp. 1–2.

¹⁹³ Dibb Review, p. 107.

¹⁹⁴ Dibb Review, p. 107.

A study by Smith of the industrial strategy required for the support of fighter aircraft will be used to illustrate the arguments.¹⁹⁵ Smith argues that there are four levels of logistical support:

- Consumables such as fuel and weapons,
- Battle damage repair,
- Modifications for combat deficiencies, and
- Replacement of lost airframes.

The impracticality of the last item in a low to medium-level conflict must be noted due to the long lead times in building a new platform.¹⁹⁶ The preceding three levels of support are important, however. The capability to modify airframes is critical because deficiencies may be found during combat operations.¹⁹⁷ The repair of airframes is obviously very important during conflict and this capability may be gained through regular maintenance, performed either by service or contractor personnel. The capability required for this is not dependent on local manufacturing capability.¹⁹⁸ Finally, consumables such as fuel, tyres and weapons are very important particularly because of limited war stock-holdings. Australia does not manufacture any operational ordnance used by the F-111 and F/A-18 fleet and therefore, from this point alone, it could be argued that limited self-reliance, as defined in this monograph, is not achieved in Australia.¹⁹⁹ Dibb argues that manufacturing more advanced weapons in Australia would not be an efficient use of resources and the conflict scenarios involving weapons are at the higher end of the threat scale rather than the more credible contingencies.²⁰⁰

¹⁹⁵ The paper investigates the industrial strategy required for the support of fighter aircraft in a developing nation. See N. Smith, *An Industrial Strategy in Support of Fighter Aircraft For Industrially Developing Nations*, 41 RAAF/APSC, Canberra, February 1996. Also see Commodore Orm Cooper (ret'd), 'Time to rethink our defence industry priorities', *Australian Defence Magazine*, Vol. 9, No. 6, June 2001, pp. 54–56.

¹⁹⁶ Dibb notes that this aim is impractical for the replacement of platforms lost in combat given the long lead times for manufacture. Even in a relatively long conflict, where an increase in capability may be required, replacement may be impractical. Dibb Review, p.110.

¹⁹⁷ Timely modifications are often required for electronic warfare purposes and the clearance of new weapons.

¹⁹⁸ The experience gained from licensed airframe manufacture can be lost very quickly. Hawker de Havilland licensed manufactured the PC-9 training aircraft in Australia in the 1980s. '[T]he PC9 (sic) support contract went to a [another] company with low man-hour rates; those rates being low not least because it did not have the engineering overheads associated with in-depth knowledge of the PC9 and its systems.' From Smith, 'Australia's Aerospace Industry and Defence', p. 71.

¹⁹⁹ Smith, *An Industrial Strategy in Support of Fighter Aircraft For Industrially Developing Nations*, p. 28.

²⁰⁰ Dibb Review, p.110.

In a study of self-reliance and industry Markowski and Hall broaden the 'limited' definition as they claim the aims of self-reliance are 'achieved through the technological sophistication of defence equipment, a highly professional but small defence force²⁰¹ and local industry support.'²⁰² DSTO and industry play an important role in providing the technological sophistication.²⁰³ The cost of adopting high technology weapons systems creates a paradox, because in order to maintain or gain a technology edge, the self-reliant posture is diminished because of Australia's reliance on imported defence equipment.

In 1984, the Hawke government delivered a new policy for defence industry that included a goal of reducing the amount of imported defence equipment.²⁰⁴ As a result of this, and the argument put in the Dibb Review for increased self-reliance, a number of significant decisions were made to support the indigenous defence industry. The policy resulted in an unprecedented increase in Australian defence industry spending since the Second World War. The shipbuilding industry was perhaps the greatest beneficiary with the building of foreign-designed ANZAC-class frigates and the Collins-class submarines in Australia.²⁰⁵ The policy supported the aim of increasing the use of high technology weapons systems but the broad interpretation of the industry element of self-reliance appeared to be equally aimed at more general government policy on increased industry activity and competitiveness.²⁰⁶ Cheeseman noted that while self-reliance was generally

²⁰¹ The small, highly professional force is not challenged, but the reasons are perhaps much less related to self-reliance than to economics. The decline in the defence budget has led to, inter alia, a reduction in force strength, but an increasingly professional, highly trained defence force. For external confirmation of the professionalism and sophistication of the ADF, refer to Eliot Cohen, 'Defending the Lucky Country', *The National Interest*, 1994, pp. 57–58, 61.

²⁰² Stefan Markowski and Peter Hall, *Defence Self-Reliance and Domestic Industry: The Australian Experience*, Working Paper No. 43, Australian Defence Studies Centre, Canberra, September, 1996, p. 1.

²⁰³ An examination of the White Papers indicates that over a number of years there was a growing acceptance for Australia to have in its declared defence policy, a technological edge over its neighbours.

²⁰⁴ 'In June 1984, the Ministers for Defence and Defence Support announced principles that have been approved by Government for the development of defence policy for industry and its implementation.' The statement was reproduced in Commonwealth of Australia, Department of Defence, *Defence Report 1983–84*, AGPS, Canberra, 1984, pp. 57–58.

²⁰⁵ Nevertheless, the aircraft industry gained from significant work in assembling F/A-18 aircraft and Blackhawk and Seahawk helicopters. Stewart Woodman, 'Exploding Myths: Defence Policy for Industry Beyond the Price Review', in Graeme Cheeseman, (ed.), *Fostering Indigenous Defence Industry*, pp. 28–30.

²⁰⁶ Woodman indicates the foreign currency benefits, unemployment and the tie in with the Labor government's desire to increase the competitiveness of Australian industry in general. See Woodman, 'Exploding Myths: Defence Policy for Industry Beyond the Price Review', pp. 28–30.

accepted during this period, it was difficult to achieve due to budgetary constraints. He concluded that Defence was pursuing unaffordable high technology capabilities that were unsuitable for Australia's circumstances and in fact left 'us vulnerable to certain forms of low- and high-level threats' and arguably less self-reliant.²⁰⁷

With the Hawke government increasing the indigenous defence industry capability, a strategy was put in place to sustain industry by way of exports. Markowski and Hall have argued that local industry support should 'achieve high levels of local content in the area of through-life logistic, as well in those areas where the local industry is or could become competitive', but little has been done to create an export based industry.²⁰⁸ There is no evidence to suggest that defence industry exports have markedly increased since the mid-eighties.²⁰⁹

²⁰⁷ Cheeseman, *The Search for Self-Reliance*, pp. 107, 135.

²⁰⁸ Markowski and Hall, *Defence Self-reliance and Domestic Industry: The Australian Experience*, p. 1.

²⁰⁹ Markowski and Hall do not provide any figures for Australian exports and they comment on the difficulties in even finding numbers employed in the Australian defence industry. Markowski and Hall, *Defence Self-reliance and Domestic Industry: The Australian Experience*, p. 21. The Australian Bureau of Statistics does not extract figures of Australian defence exports and currently the Department of Defence does not aggregate exports relating to defence industries. Reasons offered relate to the difficulties in separating dual use technology and the categorisation of intermediate products. Defence does require statistics for use under the export control regime (from discussions with Industry Policy staff, Department of Defence, October 2001). The anecdotal evidence suggests that defence exports have not grown and an investigative piece of journalism in *The Australian* confirms this evidence. An investigation into a drive to increase Australian defence sales into Asia in the 1990s indicated that the Keating vision of billion dollar sales failed. Sales to Southeast Asia were only \$500,000. See, *Australian*, 19–20 August 2001, pp. 1, 23. The distinction between defence spending within Australian industry, and spending generated by Australian exports or equipment procurement has been blurred by the Commercial Support Program. As an example, the Defence Housing Authority is the fifth largest Defence supplier. It provides a service that was once inside Defence and more importantly is simply a support function that does not lead to any direct war fighting capability. Whereas, Helitech, a company with strong DSTO technology transfer links due to its aircraft repair technology, is the 65th largest. For detail see, *Australian Financial Review*, 20 June 2001, p. 22.

Self-reliance has been shown to be a credible notion but it is poorly defined in the Australian defence context. The subsequent usage—the broad self-reliance or independence principle—without caveats such as industrial or limited self-reliance, leads to the term having little utility. It has been argued that the industrial base contributes to self-reliance, with caveats on the efficacy of an indigenous shipbuilding industry, for example, because it may have limited application to the basic premise of self-reliance; sustaining operations in low to medium level conflict without relying on external help. The science and technology element of self-reliance will now be examined.

The 1994 White Paper stated that DSTO ‘conducts research in a wide-variety of defence-related fields, focusing on areas which are unique or otherwise central to national self-reliance.’²¹⁰ Two years later in a study of strategic guidelines for enabling research and development,²¹¹ Anderson and Dibb offer an interpretation of self-reliance, claiming that, ‘under [the] policy [of self-reliance] Australia must maintain military capabilities sufficient to defend itself without depending on help from other countries combat forces’.²¹² They then argue that the ‘policy of self-reliance implies a significant level of Australian science, technology and industry support for vital capabilities’ and again where ‘Australian needs are unique’.²¹³ It is interesting to note that the White Paper broadened, or perhaps more correctly, loosened the definition of self-reliance and implied all levels of conflict. Self-reliance has been extended to encompass the broad application of science and technology, short and long-term, to a range of defence activities. The definition appears to support the claim that science and technology, as applied to all defence activities, is justified under the umbrella of independence. The notion is applied with little rigour when judging the appropriateness and priority of each activity.

²¹⁰ 1994 White Paper, p. 167.

²¹¹ Strategic research has been referred to as enabling research or ‘blue sky’ research, and some elements include basic research as well as elements of applied research. The issue of basic research was raised in Fink, *Internal Review into Objectives and Procedures of the Defence Science and Technology Organisation*. The review did not see an end to the continuing decline in enabling research. For further discussion see Ken Anderson and Paul Dibb, *Strategic Guidelines for Enabling Research and Development to Support Australian Defence*, Canberra Papers on Strategy and Defence, 115, SDSC, ANU, Canberra, 1996.

²¹² Anderson and Dibb, *Strategic Guidelines for Enabling Research and Development to Support Australian Defence*, p. xiv.

²¹³ Anderson and Dibb, *Strategic Guidelines for Enabling Research and Development to Support Australian Defence*, p. xiv.

In summary, it is important to re-iterate that self-reliance is not self-sufficiency; nor is it independence without any caveats.²¹⁴ Limited self-reliance is however the capacity to fight low to medium level conflicts with little or no outside support, using the manufacturing and supply chain to maintain an independent posture. Science and technology plays a myriad of support roles but under the limited definition of self-reliance, arguably many areas of indigenous science and technology do not contribute to this criterion. A decade later, in a discussion of science and technology, a broader more encompassing view of self-reliance is implied.

External Influences on Self-reliance

The goal of self-reliance is subject to a range of endogenous and exogenous influences. The endogenous influences include budget constraints that preclude a range of activities. On the other hand, reasons for maintaining research capabilities include national credibility and prestige and 'sentimental' reasons resulting from political pressure to maintain facilities. The endogenous influences have generally been addressed throughout the analysis but this section will investigate the various external influences on self-reliance and DSTO.²¹⁵ The RMA and global trends such as transnational mergers will be briefly described and their relationship with defence science and self-reliance will be examined.

Revolution in military affairs

The concept of a Revolution in Military Affairs (RMA) is often used widely in military literature, and as noted previously, it was first introduced into Australian defence policy in 1997. At that time, the 'RMA or the information revolution'²¹⁶ were used interchangeably. A clearer understanding of the term is required to evaluate the possible impact of the RMA on self-reliance. The RMA has arguably evolved in the last decade since it was used to describe elements of the Gulf War of the early 1990s. In previous decades, the RMA was restricted to discussions as to what constituted past revolutions in military affairs, particularly with regard to 17th century through to mid 20th

²¹⁴ Gower quotes from a 1978 Parliamentary Joint Committee on Defence and Foreign Affairs that not even in the Second World War when Australia had substantial military capacity was Australia self-sufficient, rather it developed 'a high degree of self-reliance', S.N. Gower, *Options for an Australian Defence Technological Strategy*. SDSC, ANU, Canberra, 1982, p. 3.

²¹⁵ These factors are in fact influences on Defence in general. For a Canadian perspective see Martin Shadwick, 'Lessons from Australia?' *Canadian Military Journal*, Vol. 2, No. 1, 2001, p. 53.

²¹⁶ The information revolution was seen as 'the effective exploitation of information technologies to allow us to use our relatively small force to maximum effectiveness', ASP97, pp. 55-56.

century events. Various technological advances, such as gunpowder, machine guns, tanks and submarines,²¹⁷ and their impact upon the way in which warfare was conducted, were tested by commentators against various criteria.²¹⁸ The accepted definitions, or criteria, generally add two other elements to the technological change: organisational and doctrinal change. The result of these changes leads to 'a sudden change in the practice of warfare in the context of the international situation.'²¹⁹ Sterner suggests that in examining an RMA, four fundamental military practices (manoeuvring, firepower, command and control and logistics)²²⁰ need to be viewed against the changes in technology, organisation and doctrine.²²¹

The literature generally acknowledges that the current RMA discussion may be traced back to Soviet observer Marshall Ogarkov who put forward the notion that there is 'an imminent technical revolution that would give conventional weapons a level of effectiveness in the field comparable to that of small tactical nuclear weapons.'²²² The Soviet chief of general staff was referring to long-range cruise missiles.²²³ The Gulf War appeared to be a catalyst for reviving this notion that a major advance was occurring, a new RMA.²²⁴

²¹⁷ J.H. Patton, 'The New "RMA" It's Only Just Begun', *Naval War College Review*, Vol. XLIX, No. 2, 1996, p. 24.

²¹⁸ Usually after considerable discussion they were either accepted or rejected as revolutions in military affairs.

²¹⁹ E.R. Sterner, 'You Say You Want a Revolution (in Military Affairs)?', *Comparative Strategy*, Vol. 18, No. 4, 1999, p. 303.

²²⁰ Sterner, 'You Say You Want a Revolution (in Military Affairs)?', p. 303.

²²¹ The changes in military affairs can also be argued to be evolutionary, rather than revolutionary and there are also a number of models used to help describe the 'mechanism'. For example, Murray tests a number of events in military history and concludes that an RMA may be analogous to earthquakes. There is a pre and post shock period around a military revolution. Murray uses the case of First World War as the RMA itself with the Fisher revolution forming the pre-shock RMA and, inter alia, the use of combined arms and the blitzkrieg forming the direct and aftershock. Again, the considerable time taken for an RMA to develop, even in wartime, is highlighted. The current RMA in many ways has evolved from the initial Gulf War concept of precision strike to the current information superiority view. W. Murray, 'Thinking About Revolutions in Military Affairs', *Joint Forces Quarterly*, Vol. 16, 1997, p. 73.

²²² Eliot Cohen, 'A Revolution in Warfare', *Foreign Affairs*, Vol. 75, No. 2, March–April 1996, p. 39.

²²³ *The Economist*, 8 March 1997, p. 21.

²²⁴ As a result of the media coverage from the Gulf War, US non-expert opinion 'has been virtually unanimous in endorsing this "revolution" as a welcome development', A.J. Bacevich, 'Morality and High Technology', *The National Interest*, Vol. 45, 1996, p. 38. With hindsight the Gulf War was fought with pre-RMA organisational structures and weaponry, and here it is argued that it was a mere moment in the evolution of the current RMA. F. Heisbourg, 'The Revolution in Military Affairs', *Conference on Maintaining the Strategic Edge: The Defence of Australia in 2015*, SDSC, ANU, Canberra, 21–23 September 1998, p. 6.

The evolving RMA appears to be an 'American-led revolution' in which it 'has already begun, systematically, to assemble this system of systems'.²²⁵ The main components are:

intelligence collection, surveillance and reconnaissance; technologies and systems that provide command, control, communications and computer processing; the integration of complex information in real time; and the development of the doctrine, strategies, tactic and military organisations that can take advantage of this technological potential.²²⁶

A succinct definition states that the current 'RMA revolves around three advances'; gathering of intelligence, processing intelligence and acting on intelligence.²²⁷ This has been termed 'information superiority'²²⁸—real-time intelligence from 'sensor to shooter'.²²⁹ The outcomes of the current RMA, as espoused by the US, are dominant battle-space awareness, dominant manoeuvring, precision engagement and focused logistics. The key issue is as to whether only the US can afford the concept and therefore does this further reduce the ability of small to medium powers such as Australia to remain independent or self-reliant? How can organisations such as DSTO engage in the broad range of RMA activities or is the current RMA such a vague

²²⁵ Joseph Nye and William Owens, 'America's Information Edge', *Foreign Affairs*, Vol. 75, No. 2 March–April 1996, pp. 23, 28.

²²⁶ Dibb extrapolates these elements from Nye and Owens, 'America's Information Edge' and goes on to summarise the elements of the current RMA as—'dramatic advances in fire-power, accuracy and the ability to detect targets'. This more succinct version demonstrates that the popular definitions of the current RMA often neglect to include, or perhaps assume implicitly, the development of doctrines and organisational changes. Concepts lost in the simpler summaries of the current RMA include the requirement for Integrated Logistics Systems (ILS), non-lethal warfare, and information warfare. An often-neglected element of the RMA is that the 'system of systems' revolution has substantial roots in non-military technologies, such as digital signal processing algorithms, information technology, micro electro-mechanical machines (MEMS) and low-cost sensor technology, Dibb, 'The Revolution in Military Affairs and Asian Security', pp. 93–94.

²²⁷ *The Economist*, 8 March 1997, p. 21.

²²⁸ Jacques Gansler and Delores Etter, 'Defense Wide Research and Development', Senate Armed Services Committee, Emerging Threats and Capabilities Subcommittee, 21 March 2000. www.dsb.mil, accessed 21 August 2000

²²⁹ The gathering of intelligence data is enabled by the development of sensors on Unmanned Aerial Vehicles (UAV), satellites, even digital cameras placed at various locations around the world for on-line weather reports. The processing of intelligence data is achieved by making sense of data using advanced command and control, communication and computers. The advent of precision-guided munitions (PGM) allows one to act on this data. Footage from the Gulf War showing PGM penetrating enemy installations in urban environments highlights the utility of this combination of events.

notion, that like self-reliance, it offers little utility? While the first formal mention of the RMA occurred in 1997,²³⁰ Australian defence strategists had spent much time interpreting the literature for its relevance to the ADF. Dibb identified that:

Having a highly competent defence-science community (which few countries in the region have) as well as an innovative defence-industrial base (DIB) capable of adapting such systems for the unique operating environments of individual countries, is essential.²³¹

Dibb argued that the RMA had been generally only embraced by modern defence forces such as the US, Germany, UK and France and to a lesser extent in Asia 'with [the exception] of Australia, Japan, Singapore and perhaps Taiwan'.²³² The ADF and DSTO would appear to fulfil the Dibb criteria for engaging in the RMA.

While the current RMA has been shown to be an evolutionary concept, the dominant view relates to the integration of a number of complex surveillance and reconnaissance platforms to provide a full battlefield picture, day and night and in all weather.²³³ The breadth and cost of this 'system of systems' is unarguably beyond all nations except for the US. The drive to this dominance of the conventional battlefield may force the potential aggressor to engage in asymmetric warfare. The 'system of systems' is of dubious use in countering urban terrorism, biological warfare and other unconventional threats.²³⁴

²³⁰ ASP97, p. 55.

²³¹ Dibb, 'The Revolution in Military Affairs and Asian Security', p. 103.

²³² Dibb, 'The Revolution in Military Affairs and Asian Security', p. 96. O'Neil claims that the Asian financial crisis of 1997 slowed down the East Asian countries seeking to incorporate elements of the RMA, from Andrew O'Neil, 'The Regional Security Implications of the East Asian Crisis: The Challenge of Uneven Development', p. 7.

²³³ Systems providing elements of this capability include Joint Surveillance Target Attack Radar System (J-STARS), first exercised in the Gulf War. Upgrades to J-STARS, to improve its ground monitoring capability, are also being paralleled by Army attempts to interface with the Global Hawk UAV. These two systems provide a snapshot of the increasing development of the 'system of systems' using, inter alia, high cost airborne systems, *Aviation Week and Space Technology*, 26 March 2001, p. 17.

²³⁴ The 2000 White Paper specifically states that a characteristic of the RMA is asymmetric threats, yet the literature in the mid-1990s often focused on the inappropriateness of the then RMA in dealing with such threats.

The RMA appears to be focused on conventional warfare yet the 2000 White Paper identifies the emergence of non-traditional threats.²³⁵ A number of important questions are therefore raised. First of all, is the RMA an appropriate phenomenon to drive defence policy? Secondly, if it is appropriate, can a middlepower nation such as Australia 'partially' engage in the RMA?

The RMA is discussed in the 2000 White Paper and given the evolution of the term and the articulation of the knowledge edge over the last few years the RMA cannot be ignored. DSTO policy is also affected as the Science and Technology chapter expressed the RMA in terms of 'the uptake of information technology by the military'.²³⁶ This definition is notable for two reasons. Firstly, it is simplistic in that, as argued previously, an RMA consists of a number of components leading to a dramatic change in the way war is fought. Secondly, the evolutionary aspect of the current RMA from the Gulf War indicates that references to information technology, assuming they refer to increased battlespace awareness, add little to the understanding. The problem of this looseness is that, if defence policy is built around a vague or unnecessarily broad definition of the RMA, organisations such as DSTO can interpret the direction in a multitude of ways; hence there is little benefit for strategic planning.

The second question relates to the 'partial' engagement of the RMA. It could be argued that Australia has a role in filling gaps in the US awareness of the complete battle-space and in doing this gains access but this is not self-reliance.²³⁷ In a study of 'network-enabled warfare', Ball argues that the maintenance of the technological edge 'requires (selective) exploitation of the ... RMA'²³⁸ and while this warfare is 'not entirely applicable to Australia's

²³⁵ New military tasks covered in the White Paper range from humanitarian relief, peace-keeping and peace-enforcement through to non-military security issues. 2000 White Paper, pp. 10–13.

²³⁶ 2000 White Paper, p. 108.

²³⁷ For elaboration on Australian access to inter alia US satellite information see Desmond Ball, 'Australia's Info war architecture', *Australian Defence Report*, Vol. 12, No. 8, 10 May 2001, pp. 10–13.

²³⁸ Ball, 'Australia's Info war architecture', p. 10.

circumstances' the US Navy move to network-centric warfare²³⁹ is 'extremely poignant'.²⁴⁰ The Collins-class submarines, along with JORN and the soon to be acquired Airborne Early Warning and Control (AEW&C) aircraft begin to assemble a network capable of providing some of these functions. The use of US satellite and other intelligence comes under the mantra of 'self-reliance within an alliance framework'. The RMA generally raises the question of how achievable is the goal of self-reliance? As has been stated before, self-reliance appears to be the only practicable aim for Australia keeping in mind the constraints of domestic budget, technology access and the general inability of a middlepower to 'do it all'. The selective adoption of the evolving RMA appears practicable for the ADF. DSTO would be required to provide advice to the ADF on proposed capabilities and develop capabilities for Australia's unique circumstances.

Compatibility and interoperability

Compatibility relates to the ability of particular systems to be mutually tolerant and the requirement has been present ever since the formation of professional unified military forces. Standardisation was seen as a way of overcoming incompatibilities between various services and nations but the issues facing NATO, and their drive to standards may be quite inappropriate for a nation operating predominantly in a very different environment, the northern tropical regions for example.²⁴¹

The compatibility concept evolved as the various single services began to operate with each other and then train and operate with allies. In the 1976 White Paper the principle had evolved to where it was noted that Australian military technology should be 'compatible with, but not necessarily equal in technical advancement ... with larger allies'.²⁴² The ability of various services, from both within Australia, and outside nations, has been a key concern for a number of years.²⁴³ Interoperability is one of Australia's capability

²³⁹ For a discussion on network centric warfare see David Alberts, John Garstka and Frederick Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2nd edn, CCRP, August 1999.

²⁴⁰ Ball, 'Australia's Info war architecture', p. 10.

²⁴¹ As an example, NATO has a plethora of standards ranging from ammunition sizes through to aircraft refuelling practices. The issues facing NATO were obviously far greater than Australia faced in operating in Vietnam beside the US.

²⁴² 1976 White Paper, p. 14.

²⁴³ Dibb Review, p. 57.

development principles. As the 2000 White Paper noted, interoperability is not only based on allied operations but also those with 'other countries with whom we might want to operate in coalition'.²⁴⁴ Interoperability issues with the US dominate, not unexpectedly given the US 'relationship[s] shape, depth and weight'.²⁴⁵ The US alliance will be briefly examined and the issue of interoperability examined in relation to its impact on self-reliance.

The US–Australian alliance brings a number of advantages to the Australian defence forces. The training and operations with the high technology US forces give Australia a range of benefits outside of the umbrella of protection from attack from a major threat. The alliance gives Australia access to US high technology but due to the US technology lead, arguably driven by the RMA, there has been increased difficulty in maintaining compatibility with US forces so as to allow for interoperability.²⁴⁶ The primacy of interoperability in the US alliance has been the subject of high level discussions²⁴⁷ and was reinforced by William Cohen during a visit to Australia in which he stated:

[T]here will have to be additional investment if Australia hopes to maintain a modern interoperable force with the United States and other allies. And so this is a requirement for all our allies.²⁴⁸

The pressure resulting from statements such as these do impact on the ability of Australia to be self-reliant or independent but at a practical level it is a *fait accompli* that US compatibility and interoperability will dominate capability choices.²⁴⁹ As an example, the current dominant position of the US in global

²⁴⁴ The White Paper notes that interoperability is not restricted to allied operations but it also covers 'other countries with whom we might want to operate in coalition', 2000 White Paper, pp. 54–55.

²⁴⁵ 2000 White Paper, p. 34.

²⁴⁶ For example, Australia was unable to deploy F-111 aircraft to the Gulf War because of lack of electronic warfare protection capability as well as communication incompatibility.

²⁴⁷ The interoperability issue was raised in the Australia–US Ministerial talks in 1996 in the context of increased readiness and ability to operate overseas. Derek Woolner, 'Back to Asia: Developments that Shape the Future Australian Defence Force', in Ian McLachlan, et al., *Australia's Strategic Dilemmas: Options for the Future*, ADSC, ADFA, Canberra, 1997, p. 110.

²⁴⁸ William Cohen, 'Transcript of interview by Laurie Oakes', *Sunday*, National Nine: unpublished, 16 July 2000, www.rehame.com.au/mtp, accessed July 2000.

²⁴⁹ The issue of maintaining interoperability with the US is of concern to a number of US allies. The increasing gap between NATO and the US appears to be widening further as '[t]he US is embarking on a surge of scientific innovation', *The Times*, 3 May 2001, p. 19.

affairs, both in the civil and military arena, standards, de facto or real, are most likely to be set by the US.²⁵⁰ While interoperability with the US appears to take precedence in Australian defence planning, training and operations, Dibb argues:

[There is] a tendency ... to drift towards making our first priority interoperability... Clearly, as America's ally in the Asia-Pacific region we need to be able to have a credible level of interoperability. But ... not... at the expense of giving priority to our own defence self-reliance.²⁵¹

The question remains as to the impact of compatibility and interoperability on indigenous defence projects. There is no clear evidence to suggest that indigenous projects are rejected because of interoperability and compatibility requirements and furthermore it would be reasonable to expect any major industrial proposal for defence would be based around compatibility and interoperability requirements.²⁵²

The increasing complexity of the RMA-era operations²⁵³ may lead to further pressures on Australia's interoperability but current requirement for 'datalinks and other forms of communication, ...[and] in logistics support chains, ... doctrine and tactics' are still aimed so that Australian operations 'integrate seamlessly' with the US.²⁵⁴

²⁵⁰ For example, computing language standards through to material standards, the building blocks of the software and hardware fields, are dominated by the US.

²⁵¹ Paul Dibb, *Australia's Strategic Policy and Force Structure Priorities: Some Implications for the National Support Base*, Working Paper No. 56, ADSC, ADFA, Canberra, December 2000, p. 5.

²⁵² Project Nulka, the DSTO developed hovering rocket decoy but with a US electronic payload, is an example of how joint development may avoid compatibility issues.

²⁵³ The advent of Theatre Missile Defence systems will raise the issue to a higher level because 'unless all systems—sensors, weapons, and communications—are fully interoperable, these complex theater missile defense "systems of systems" cannot be effective', Jacques Gansler, 'Twenty First Century Coalition Warfare: Implications for the Military and for Industry', XVIth NATO Workshop, Budapest Hungary, unpublished paper, 19 June 1999. www.dsb.mil, accessed 21 August 2000.

²⁵⁴ Vice Admiral David Shackleton, 'From the Source', *Australian Defence Magazine*, April 2001, p. 45.

Global defence industry trends

Globalisation²⁵⁵ is a broad concept that, like self-reliance, offers little utility. Global trends including the acceleration of company mergers particularly across national boundaries, instantaneous communication, and 'increasing commercialisation of militarily useful products and technologies' are often packaged under the banner of globalisation.²⁵⁶ The increasingly sophisticated technologies are a result of increased research and development budgets. Globalisation *per se* impacts state security but the connection with defence policy, and in particular on defence science policy, is too broad.²⁵⁷ Nevertheless, defence budgets have been decreasing,²⁵⁸ the RMA, which utilises many elements of the rapid increases in communication, are observable trends that influence defence policy. Australia, although relatively small in size and stature, reflects number of these trends. The trends will be examined in the light of the principle of self-reliance and its link to indigenous defence science.

²⁵⁵ 'Globalisation is a portmanteau term whose definition is more often avoided than attempted; the perspective of the author clearly matters', Julius, D., 'Globalization and stakeholder conflicts: a corporate perspective', *International Affairs*, Vol. 73, No. 3, July 1997, p. 453. For further reading on the positive 'popular press' views of globalisation refer to Friedman, Thomas, *The Lexus and the Olive Tree*, Harper Collins, London, 2000. For analytical reviews see A.J. Bacevich, 'Policing Utopia: The Military Imperatives of Globalization', *The National Interest*, 1999, pp. 5–13, Ian Clark, *Globalization and Fragmentation—International relations in the Twentieth Century*, Oxford University Press, London, 1997; James Rosenau, 'Complexities and Contradictions of Globalisation', *Current History*, November 1997, pp. 360–64; Jean Van Scherpenberg, 'Transatlantic competition: the trade-defence link', *International Affairs*, Vol. 73, No. 1, January 1997, pp. 99–122; Waltz, K., 'Globalization and American Power', *The National Interest*, 2000, pp. 46–56.

²⁵⁶ James Canan, 'Globalisation: The DSB speaks out', *Aerospace America*, July 2000, p. 34.

²⁵⁷ R. Brabin-Smith, 'Globalisation: Defence Technologies and Research', Defence Industry Advisory Council, unpublished paper, 2 March 2000.

²⁵⁸ Elaine Camhi, 'Editorial: Welcome to the new arms race', *Aerospace America*, Vol. 38, No. 9 September 2000, p. 1. The global decrease in defence spending has been 35.5% for the period from 1985 up until 1999. The most significant reductions were for Soviet Union/Russia and NATO (including the US). Increases were noted for Central and South Asia, East Asia, Australia, the Caribbean and Latin America. For further figures on the global decline in defence expenditure see Stewart Penney, 'Forecasts 2001: The year ahead—Defence', *Flight International*, 2–8 January 2001, pp. 31–32.

Mergers have been a phenomenon since the days of colonialism. As companies grew in size, stature and power, other lesser companies were taken over. In the last two decades there has been an apparent acceleration in the merging of both national and transnational firms. This trend has been due to a number of factors including the increase in international competitiveness and the desire to maintain revenue growth by acquiring similar companies or increasing the breadth of activities.²⁵⁹ For example, aircraft manufacturing companies, both in Europe and the US have acquired defence electronics companies.²⁶⁰ Airframe manufacturing is still a labour intensive activity that has arguably reached a plateau in technology whereas electronics are now the largest component cost of most modern weapons systems. Leading edge companies require 'critical mass and total systems capabilities' and hence 'horizontal integration within [the] industry has been a logical development'.²⁶¹ The increase in competition for contracts due to declining budgets, and the significant increase in development costs of platforms add further pressure. As a result all but a few large firms can afford the development cost of a major defence project.²⁶² In parallel, the global trend has been for increase in the sale of advanced, conventional weapons and in technology transfers since the end of the Cold War by a fewer number of companies.²⁶³

²⁵⁹ The US GAO claimed that defence industry mergers in the three years prior to 1999 led to savings of US\$2bn. Jacques Gansler, 'The Defense Industry Base in the 21st Century', Aviation Weekly, Aerospace Finance Conference, New York, 14 April 1999. www.acq.osd.mil/dsb/reports/sandt21.pdf, accessed 5 December 2001.

²⁶⁰ Aircraft companies acquiring defence electronics companies include, General Electric attempted to acquire Honeywell, Northrop Grumman acquired Litton, Thompson-CSF (now Thales) acquired Racal Electronics. British Aerospace, merged with GEC-Marconi, an avionics company, to form BAE Systems. It should be noted that the manufacturing process is now often outsourced while the high value and intellectually challenging areas, are still essentially performed by the parent company. For a review of the mergers see Chris Jasper, 'Forecasts 2001: The year ahead—Aerospace', *Flight International*, 2–8 January 2001, pp. 25–26.

²⁶¹ James Jackson, 'Reshaping of the defence industry', *Janes Defence Weekly*, 25 November 1989, p. 1153.

²⁶² For example, 3000 aircraft are being built under the US Joint Strike Fighter program at a cost of US\$200bn. See *Washington Post*, 28 December 2000, p. E1. In order to spread the development costs, the project is supported by a range of nations. Similarly, in the civil aviation sector the development costs are high. The Airbus A380 long-range transport development is estimated at US\$12bn. For more detail see *Financial Times*, accessed www.ft.com/ftsurveys/industry/sc22362.htm 27 July 2000. Both these projects distribute work over a wide range of companies.

²⁶³ Dibb, 'The Revolution in Military Affairs and Asian Security', p. 99

The globalisation trend has also led to a denationalisation of defence industries.²⁶⁴ A critical issue is the perceived 'erosion of national sovereignty'.²⁶⁵ The US has not, as yet, succumbed to these pressures,²⁶⁶ because of market leadership in many areas, the 'lack of clarity in US defence policies on mergers and acquisitions' and an 'overly burdensome regulatory environment'.²⁶⁷ Congress has faced the wrath of a number of US companies who claim sales losses due to these restrictions. The national mergers within the US are nevertheless causing concerns because of the reduced opportunities for competition, and as result, efficiency and innovation.²⁶⁸ The trend for the civil sector to lead the field in previously critical technologies and the complexities of company structures all add pressure to the current US stance. Again in Australia, a microcosm of these trends is seen, for example in the aircraft industry.²⁶⁹ Mergers and changes of ownership by overseas-based parent companies can also have significant implications for local ownership as illustrated by the Australian Submarine Corporation.²⁷⁰ The reduction in choice of companies and the interdependence increase Australia's requirement for independent defence science capability including support to evaluating competing capability bids.

²⁶⁴ The trend has been strongest in Europe with establishment of organisation such as BAE Systems, Airbus and the European Aeronautic Defence and Space (EADS) Company. The change of name by British Aerospace to BAE Systems is an indication of the transnational resources of many corporations. The company notes that more of its business is generated in the North American market than Britain. Camhi, 'Editorial: Welcome to the new arms race', p. 1.

²⁶⁵ Jackson, 'Reshaping of the defence industry', p. 1153.

²⁶⁶ It should be noted that among the significant western arms producing nations, the US, France and Germany do not allow foreign takeovers of defence industries.

²⁶⁷ Canan, 'Globalization: The DSB speaks out', p. 38.

²⁶⁸ In 1999, the top 5 defence companies were 50 independent defence firms 10 years earlier. Gansler, 'The Defense Industry Base in the 21st Century'.

²⁶⁹ As an example, Boeing acquired Hawker de Havilland in 2000. Boeing had previously acquired Aerospace Technologies of Australia, which prior to privatisation was called the Government Aircraft Factories (GAF). See Trevor Thomas, 'Sensible rationalisation for local aerospace industries', *Australian Defence Business Review*, Vol. 19, No. 15, 20 October 2000, p. 9.

²⁷⁰ After the sale of the Australian Submarine Corporation, the Commonwealth buy-back of Swedish Kockums Pacific, and then the parent companies sale to the German company, HDW, raised issues because the transnational commercial relationships did not align with the alliance boundaries. The Commonwealth proposal to sell the stake to a strategic investor has raised the issue of the suitability of national versus foreign ownership, *Canberra Times*, 31 October 2000, p. 3.

The general global trend for companies in competitive industries has been to increase spending on research and development. The gap between the US and the rest of the world in defence research and development expenditure is an order of magnitude.²⁷¹ The strength and breadth of the US research and development spending is exemplified in the field of basic research. Basic research in fundamental fields, such as physics, is usually long-term research. In the US it is aimed at, and in effect does provide, the US 'military technological superiority.'²⁷² In addition to federal funding, US and European defence companies commit large sums to research and development whereas in Australia there are low levels of R&D in industry.²⁷³ Furthermore, R&D undertaken in Australia by transnationals is poor.²⁷⁴ As a result of this low R&D spending organisations such as DSTO are expected to cover a broad range of technologies and partnerships or alliances between industry and DSTO are used to bolster R&D.²⁷⁵

²⁷¹ The US spends US\$37bn on defence R&D compared to the NATO countries collectively spend US\$4bn (in 1999 US currency terms), John Hamre, 'Opinion—Europe must close the technical gap', *Janes Defence Weekly*, Vol. 33, No. 13, 29 March 2000, p. 28. In comparison, DSTO's expenditure was A\$239m in 2000, Ian Chessell, 'From the Command Post', *DSTO Connections*, 55, December 2001, p. 2.

²⁷² In these fundamental fields, physics, chemistry, electronics for example, the Department of Defense spends 7% of the total US federal funding. The success of this investment may be judged by the support it gives to 69 Nobel laureates and by the development under this funding of technologies such as the Global Positioning System (GPS). Gansler and Etter, 'Defense Wide Research and Development'.

²⁷³ Martin, *The Core Capacity of Australian Science and Technology*, pp. 4, 26, 32.

²⁷⁴ Martin, *The Core Capacity of Australian Science and Technology*, pp. 3,4,18,19.

²⁷⁵ Figures on Research and Development expenditure were collected in 2001 but have not been published. They reflect the trend that multinational global companies to spend relatively little in Australia whereas local high technology companies, eg sonar technology, have high levels of R&D. Private conversation with staff at Defence Industry Policy, Department of Defence, 2001. Figures published in 1998 indicated that 'R&D expenditure currently accounts for 2.4% of all Defence outlays', Peter La Franchi, 'CTD Program to be Expanded', *Australian Defence Business Review*, Vol. 17, No. 9, 12 June 1998, p. 12. DSTO's budget in 2000 is '2% of the Defence budget'. While these percentage numbers are for slightly different years they do indicate that the industry R&D contribution is small (approximately .04% of total defence outlays), Chessell, 'From the Command Post', p. 2.

Modern weapon systems have become increasingly complex and the inability of any company to singularly develop a system has led to risk sharing by way of joint ventures, alliances and consortia.²⁷⁶ The decline in defence budgets and the high development costs and long development times has led to a significant reduction in the number of new weapon system programs.²⁷⁷ As a result, platforms are being kept in service for much longer periods.²⁷⁸

For a middlepower, this reduced 'choice' also leads to an increased dependence on foreign manufacturers and in the case of military sales, usually governments as well. It should be noted that the rationalisation of defence companies also impacts the US defence technical superiority as programs occur across national boundaries in order to reduce program costs, or to satisfy national objectives of offsetting purchases with local production, and critical technologies may be embedded in military platforms thus creating difficulties in export, eg stealth technology.²⁷⁹ The replacement of the RAAF F-111C and F/A-18 will be used to illustrate a number issues.²⁸⁰

²⁷⁶ Airbus Industries is arguably the best example of how to overcome crippling development costs and create a viable manufacturer. Refer to James Jackson, 'Reshaping of the defence industry', *Janes Defence Weekly*, 25 November 1989, p. 1153.

²⁷⁷ Current complex systems are taking up to 18 years to develop compared to commercial information cycle times of 18 month. Jacques Gansler, 'Defense Acquisition: A strategy for meeting Global security needs', 1999 DoD Procurement Conference, Norfolk, Virginia, 26 May 1999. www.dsb.mil, accessed August 2000.

²⁷⁸ The first six F-111C aircraft arrived in Australia on 1 June 1973 and the type is due to leave service in 2020, almost 50 years later. The loss of new programs is leading to significant issues in sustaining body of scientists and engineers for future development programs. For elaboration on the F-111 program see Parnell and Boughton, *Flypast, a record of aviation in Australia*, pp. 305–07.

²⁷⁹ There are two elements to this argument. Firstly, in the US there are now only two major combat aircraft airframe designers and manufacturers. The transnational mergers are seen as part of globalisation and while the US is a leading proponent of this phenomenon, Moran notes 'the lack of attention by liberal economics to the security dimensions of globalization is unacceptable' and argues that a 'new era of managed interdependence' is the most favourable solution. Theodore Moran, 'The Globalization of America's Defense Industries: Managing the Threat of Foreign Dependence', *International Security*, Vol. 15, No. 1, 1990, p. 59. Secondly, the US dominance in critical areas of combat aircraft designs, for example, stealth, has led to severe restrictions being placed on access or export of these technologies. Even with the multinational Joint Strike Fighter program, there are indications that certain technologies will not be made available to export customers. In the case of JSF they may prove difficult to quarantine, as they are fundamental part of the aircraft design. *Janes Defence Weekly*, Vol. 35, No. 25, 20 June 2001, p. 65.

²⁸⁰ The AIR 6000 project is examining capability options and not a direct replacement of the strike and tactical fighter aircraft currently in service.

Firstly, Australia has little ability to influence the aircraft design for its mission requirements, range, payload, environmental conditions because inter alia it is a small market in comparison to the much larger northern hemisphere markets.²⁸¹ Secondly, local production may be impractical for small procurement numbers and even if some economies of scale are possible, the local production premiums may be difficult to justify, particularly on defence grounds only. The impact of large overseas manufacturers was noted in the DER where it was found that small and medium sized Australian firms were discouraged from competing against large established firms, and thus 'denying Defence access to the most innovative element of industry'.²⁸² DSTO support for the 'force-in-being's' day-to-day problems are at odds with innovation, particular when long term strategic research is dropped in favour of meeting short-term pressures.

The impact of the global trends of increasing cost and complexity of military systems, including research and development are analogous to Australia's notion of 'self-reliance within an alliance framework' model for security. Australia's independent industrial and science capabilities can be argued to be capable of only dealing with the complete development of small to medium-size projects. In large-scale projects Australia is reliant on the alliance for access to the technology.

²⁸¹ The enormity of the Northern Hemisphere defence markets are reflected in the annual NATO defence market of US\$188bn (in 1999 US currency) not including the USA which spends US\$283bn (in 1999 terms). Hamre, 'Opinion—Europe must close the technical gap', p. 28. Australia's Defence budget in 2000 was \$12.2bn (in 2000 Australian currency). Gregor Ferguson, 'White Paper focuses on missions, budgets', *Australian Defence Magazine*, Vol. 9, No. 1, December 2000–January 2001, p. 5. The US defence budget numbers are approximately 30 times greater than those of Australia.

²⁸² Bob Wylie, 'Industry Policy & Logistics', in Smith, Hugh (ed.), *From Tail to Teeth: Implications of the Defence Efficiency Review*, Special Report No. 4, ADSC, Canberra, July 1997, p. 18.

CHAPTER 4 THE DEVELOPMENT OF DEFENCE SCIENCE

In this chapter the path that has led to the current level of defence science capability will be explored. The depth and experience of defence science and technology in Australia will be examined but the primary focus will be on how particular elements of science and technology developed.²⁸³ There is a fusion in the interests of defence, industry and science and technology that have been developed in a mutually reinforced framework. In the late 1930s industry leaders pushed the government to support the development of an industrial capability to meet a defence threat. Governmental support took the form of a science and technology organisation. The process has evolved to a point where, in simple terms, Defence either wants some capability and it uses DSTO to develop it, or DSTO develops a capability and then markets it to Defence.²⁸⁴ In some instances the projects are based upon defence policy objectives whereas in others, the concepts or technologies are first developed and retrospectively 'found' to fit an existing capability requirement. The nature of the defence industry has changed since the interventionist days of the early aircraft industry and the current status of DSTO and industry will be examined. External relationships with local and overseas laboratories and academia have been used to augmented in-house capabilities and these will be examined for their impact on self-reliance.

The Genesis of DSTO

The nascent defence industry was driven by both government desires for manufacturing capability and private industry's enthusiasm that led to limited self-reliance. The earliest example appears to be the factory for the production of small arms ammunition by the Colonial Ammunition Company in Maribyrnong, Victoria in the 1880s. A small Defence Scientific Laboratory was established at Victoria Barracks in Melbourne in 1910 in support of the

²⁸³ CSIR's role in the development of ARL was fundamentally driven by the desire to support an aeronautical industry and similarly the predecessors of MRL were a direct result of support to the small arms industry.

²⁸⁴ DSTO support to the Collins-class submarine supports the former case whereas the DSTO development of JORN fits the latter case.

enterprise. By the beginning of the First World War in 1914 the industry was faced with a number of technical problems beyond its capacity.²⁸⁵ The Munition Supply Board was established and in 1922 the Munitions Supply Laboratories were opened. The postwar period led to increased emphasis on developing Australian resources.²⁸⁶ During the 1930s, there was emerging concern over Japan's ambitions in the region and this then led to an emphasis on secondary industries. While government concerns were articulated they did not result in a significant change on its part.²⁸⁷

In the case of the aircraft industry a mission was formed in 1936 to explore a suitable aircraft for local production.²⁸⁸ At a similar time, H.E. Wimperis from the British Air Ministry was chosen to advise on 'the inauguration of aeronautical research' in Australia.²⁸⁹ In December 1937, six months after his arrival, he reported that 'an Engineering Research Establishment' should be established.²⁹⁰ The first Chief of the Division of Aeronautics, established

²⁸⁵ Problems with steels used in the production of small arms and shells led to a report by a visiting expatriate Australian, Dr Rosenhain in 1914. The report, based on the British experience with industry and the requirements for scientific support, using establishments such as the National Physical Laboratories, met with some trepidation by the government. The National Physical Laboratories had a number of roles including national standards of length and mass, testing of materials and investigate and advise on difficulties in industry. Other proposals were then developed, such as a centralised munition area at Tuggeranong. A.E. Leighton was appointed the Controller of the Arsenal Project, was sent to the UK to assist in the development of new British explosives and filling factories. During this period he refined the concepts of the Arsenal Project. The project did not proceed. For elaboration see Wisdom, *A History of Defence Science*, pp. 9–15.

²⁸⁶ In 1926 the Council for Scientific and Industrial Research (CSIR) was formed, albeit with emphasis on primary industry. <http://www.csiro.gov.au/csiro/75thann/1920.html>, accessed 10 December 2001.

²⁸⁷ Essington Lewis, the Chief General Manager of BHP, was concerned at the growing militarism after a world tour in 1935. Soon after he established a syndicate with the objective of developing both an aircraft and automobile industry, the latter with the potential to support defence. BHP's Lewis along with other representatives from industrial companies such as ICI and General Motors (Holden) formed the syndicate. For detail see, Profile Publications Research Staff, *The Commonwealth Wirraway*, 154, Profile Publications, Surrey, 1967, p. 3.

²⁸⁸ The mission resulted in the selection of the North American NA-33 trainer, a relatively manageable and simple aircraft. The choice of a non-British aircraft provoked some protest in Parliament. The decision was received by the British Air Ministry 'with very great regret'. For elaboration see Parnell and Boughton, *Flypast, a record of aviation in Australia*, pp. 143–45.

²⁸⁹ Wimperis was a former Director of Scientific Research in the Air Ministry.

²⁹⁰ In addition, a 'Chair and a Department of Aeronautics' was to be established at a university. H.E. Wimperis, *Report on the Inauguration of Aeronautical Research in Australia—dated 21 December 1937*, Commonwealth Government Printer, Canberra, 28 April 1938, p. 3.

within the CSIR, was appointed in August 1938.²⁹¹ The speed with which the reports and actions were acted upon was notable.²⁹² While the industrialists led the push the government soon followed. The Minister for Defence of the time stated that 'it was increasingly difficult to obtain delivery of the equipment and in time of an emergency it would be quite impossible... [it was] vital to Australian requirements for aircraft to be manufactured in Australia and to the fullest extent possible from raw materials procurable in Australia'.²⁹³ The role of industry and scientific research support in the quest for a self-reliant, merging on self-sufficient, security posture has its genesis in the CSIR of 1939. The success of the CSIR's Division of Aeronautics has a well-documented role in supporting the industry and the success can be traced back to the intimate relationship with the war-effort focused factories.²⁹⁴ The interventionist nature of the government had many precedents, as well as antecedents.²⁹⁵ After the Second World War a number of research areas

²⁹¹ L.P. Coombes the first Chief retired in 1964 as the Chief Superintendent. Wisdom, *A History of Defence Science*, p. 122.

²⁹² The urgency could be attributed to both the emergence of the Axis powers, again Japan in particular, and the requirement to develop of secondary industries to support a possible war effort.

²⁹³ The Minister for Defence of the time was pushing for the manufacture of aircraft and at a public political meeting in 1936 he made the statement. Parnell and Boughton, *Flypast, a record of aviation in Australia*, p. 143.

²⁹⁴ The Division of Aeronautics established at Fishermens Bend in Melbourne, was located beside the newly established General Motors (Holden) factory, which enabled a focus on the fledgling manufacturing industry. The neighbouring aircraft companies comprised the private sector Commonwealth Aircraft Corporation and during the War, the Government-owned Department of Aircraft Production. The other Australian aircraft manufacturer of the time was and Hawker de Havilland, based at Bankstown, NSW. Commonwealth of Australia, *The Leading Edge: Sixty Years of Aeronautical Research and Development of Australia's Defence—1939–1999*, DSTO, Melbourne, 1999, p. 128.

²⁹⁵ For elaboration on government intervention to encourage the industrialisation of Australia, including Chifley's involvement with Holden, see David Day, 'Train driver rebuilt a nation', *Australian*, 21 November 2001, p. 13. Other examples include government intervention in banking, shipping and airlines. The extent of this intervention would arguably be unsupportable in today's environment because of domestic concerns as well as global market perceptions of 'unfair subsidies'. Government support changed from the Hawke and Keating view of picking winners to more subtle methods. As an example, the Defence Material Organisation's (DMO) Inspector General Industrial Policy noted that the, 'Government looks to industry to rationalise in a sensible manner to ensure the sustainability of key defence sectors.' Trevor Thomas, 'Reith positioning for a major defence-industry policy change', *Australian Defence Business Review*, Vol. 20, No. 12, 21 August 2001, p. 7.

gained international success including aircraft fatigue life estimation and the development of the black box data recorder. The industrial capacity was no longer required by the rapidly retracting military and the question was begged as to what to do with the capability and capacity.²⁹⁶

The significant feature of this period was the development of the Long Range Weapons Establishment in Salisbury, South Australia in 1947.²⁹⁷ The Anglo–Australian Joint Project, an ‘arrangement between the Australian and British governments in November 1946 to establish a rocket range for the testing and evaluation of long range guided weapons’ was the catalyst for the development of Woomera and the research and support facilities at Salisbury.²⁹⁸ The research was primarily funded by the UK and as such, Australian strategic planning was peripheral beside the maintenance of the Australian–British links. The benefits to Australia were derived from the chance to work at the leading edge of this technology.²⁹⁹ The opportunity bought with it the commitment to provide an Australian test ground for British nuclear explosions.³⁰⁰ Australia’s early space activity was linked to the

²⁹⁶ As an indication as to the extent to which Australia had built its military force, at the end of the Second World War the RAAF was the fourth largest Allied Air Force after the US, UK and Russia.

²⁹⁷ The Australian Defence Scientific Service (ADSS) was formed in 1949 in the Department of Supply. The ADSS initially consisted of the Long Range Weapons Establishment, Munitions Supply Laboratories and the Material Research Laboratories. At around this time the executive of the CSIR decided to cease defence work and the Aeronautical Research Laboratories was transferred to the ADSS. Underpinning this decision was the desire of the defence hierarchy to gain direct influence on an organisation fundamentally dealing with defence interests. Another issue was the dilemma facing the scientists and engineers publishing in the open literature for scientific reward in an organisation such as CSIR, compared to the restrictive requirements for classified defence work. The security issue is an ongoing problem, as the research environment has been traditionally focussed on publishing in the open literature and as the focus of the defence science organisation has shifted to operational support, often with security restrictions, there is a conflict for the scientists and engineers.

²⁹⁸ The Anglo–Australian Joint Project came into formal existence on 1 April 1947. It is simply referred to as the Joint Project in the monograph. Salisbury is located just north of Adelaide and Woomera is northwest of Adelaide in the South Australian desert. Morton, *Fire Across the Desert: Woomeras and the Anglo–Australian Joint Project*, p. 26–27.

²⁹⁹ As an example, in 1951 construction of a 15-inch supersonic wind tunnel was commenced in Salisbury, South Australia. ARL reorganised, and a High Speed Aerodynamics Division was established in Salisbury to operate the tunnel. www.dsto.defence.gov.au/corporate/history/jubilee/index.html, accessed 21 November 2001.

³⁰⁰ As an example, ‘[t]wo low-yield atom bombs were detonated at Maralinga, South Australia in October 1953 during a series of tests conducted by both the British and Australian Governments into the effects of nuclear explosions’. Six RAAF CAC Mustangs were stationed at varying radii from the blast to gauge the effect. Peter Anderson, *Mustangs of the RAAF and RNZAF*, Reed, Sydney, 1975, p. 71.

Joint Project this included support to the UK Black Knight rocket warhead-testing program.³⁰¹ The program provided the foundation for the successful launch of the Australian Defence Scientific Service's (ADSS) WRESAT in November 1967.³⁰² The program appears to have been driven purely by a desire to be at the forefront of technology and no connection to defence strategy is obvious other than the continuance of the Australian–British relationship. The demise of these programs may be attributed to the lack of the strategic planning and limited Defence hierarchy support.³⁰³ The UK activities did fill the vacuum created after the Second World War.

The Second World War and postwar period up until the 1960s was seen as the 'golden' era of defence science research. In a recent review of this period it was noted that 'the policy of these post-war years was driven by the perceptions of Australia having to play its role in arming the Western Alliances against the threat opposed by both European and Asian communism.'³⁰⁴ The projects were developed without the Australian defence environment in mind and there was a notion that the weapon systems developed would be handed to the predominately government-owned industry and quickly turned into defence capability.³⁰⁵ Some projects came by way of direct UK guidance—Jindivik unmanned target aircraft,³⁰⁶ whereas others were developed with Australian requirements in mind—Ikara.

³⁰¹ The first Black Knight rocket, designated BK01, was fired from Woomera on 7 September 1958. Morton, *Fire Across the Desert: Woomeras and the Anglo–Australian Joint Project*, p. 423.

³⁰² In 1955, the Long Range Weapons Establishment and the Research Laboratories, Salisbury (Chemical and Physical Research Laboratory and Electronic Research Laboratory formed in 1949) were reorganised into the Weapons Research Establishment. The Aerodynamic Division (the old ARL High Speed Aerodynamics Division) also became part of WRE, Wisdom, *A History of Defence Science*, pp. 239–40 and www.dsto.defence.gov.au/corporate/history/jubilee/index.html, accessed 10 December 2001. The WRESAT was an acronym from WRE Satellite. The launch vehicle for the satellite was an ex-US Redstone rocket. Morton, *Fire Across the Desert: Woomeras and the Anglo–Australian Joint Project*, p. 224. For a complete history of the rocket program see Morton, *Fire Across the Desert: Woomeras and the Anglo–Australian Joint Project*.

³⁰³ In an assessment of the Joint Project it was noted that there was a 'paucity of hard evidence for the project's having increased Australia's military strength', Morton, *Fire Across the Desert: Woomeras and the Anglo–Australian Joint Project*, p. 549.

³⁰⁴ Don Sinnott, 'Developments in the Defence Science and Technology Organisation', Frank Cain, (ed.), *Arming the Nation: a history of defence science and technology in Australia*, Australian Defence Studies Centre, ADFA, Canberra, 1999, p. 110.

³⁰⁵ Australia was primarily allocated guided weapons programs. However some aircraft programs were advocated. The Anglo–Australian AA.107 supersonic trainer is one of a number of projects that were commenced with no Australian defence requirement. *Aircraft*, Vol. 49, No.1, October 1967, p. 17

³⁰⁶ For elaboration on the design and development of the 'high speed pilotless target aircraft to specifications ... provided by the British Ministry of Supply' see Ian Fleming, 'Thirty Years Later—Jindivik in Retrospect', *Aerospace*, Royal Aeronautical Society, November 1979, pp. 14–15 and Tony Self, 'Jindivik', *Aviation Heritage—Journal of the Aviation Historical Society of Australia*, Vol. 22, No. 2 (undated), pp. 24–28.

DSTO: Inside Defence

After the 1973 Tange Report a single Department of Defence was created and in 1974 the ADSS became DSTO.³⁰⁷ The traditional discipline research bases at ARL, MRL and WRE were soon to evolve away from their roots.³⁰⁸ In 1978, Defence Research Centre-Salisbury (DRCS) was formed and this fundamentally altered the Salisbury laboratory's programs and directed them into the defence arena. The laboratories shifted away from guided weapons, particularly rocketry,³⁰⁹ into areas including 'undersea warfare, missile ballistics, radar detection, electronic warfare and surveillance and detection'.³¹⁰

DSTO was re-organised in late 1987 to reflect changed economic circumstances and the defence policies of the 1987 White Paper.³¹¹ As a result of an ASTEC report,³¹² the DSTO charter was broadened to include

³⁰⁷ The amalgamation of Defence and the creation of DSTO brought with it a number of laboratory name and function changes. On this point, see Commonwealth of Australia, *Weapon Systems Research Laboratory Information Handbook*, DSTO Salisbury, May 1988, Foreword.

³⁰⁸ At the time of the formation of DSTO the laboratories consisted of the following disciplines. **Aeronautical Research Laboratories:** aerodynamics, structures, mechanical engineering, systems and materials divisions, Commonwealth of Australia, Department of Supply, *Aeronautical Research Laboratories Annual Report 1972–73*, AGPS, Canberra, 1973; **Weapon Research Establishment:** applied physics, engineering, trials, weapons research and development wings, Commonwealth of Australia, Department of Supply, *Weapons Research Establishment Annual Report 1972–73*, AGPS, Canberra 1973, pp. 42–46. In 1978 there was further re-organisation and the Defence Research Centre—Salisbury was established from AEL, WSRL and ERL, see Wisdom, *A History of Defence Science*, pp. 230, 236, 242; **Materials Research Laboratories:** metallurgy, organic chemistry (textiles, fuels, environmental), physical chemistry (explosives), physics (lasers, optics). For elaboration on the formation of the Materials Research Laboratories (on 19 September 1974) from the Defence Standards Laboratory in the Department of Manufacturing Industry see Commonwealth of Australia, Department of Defence, *Material Research Laboratories Annual Report 1974–1975*, AGPS, Canberra, 1975, p. 6. Additionally, for a brief history of the Materials Research Laboratory see Terry Barclay (ed.), *West of the Yarra Up Maribyrnong Way*, Materials Research Laboratory, Ascot Vale, 1991.

³⁰⁹ On 30 June 1980 the Joint United Kingdom Project Agreement was formally closed thus marking an end to the strong rocketry program, Wisdom, *A History of Defence Science*, p. 154.

³¹⁰ Wisdom, *A History of Defence Science*, p. 152.

³¹¹ Five laboratories were formed, Aeronautical Research Laboratory (with a component in Salisbury), Electronics Research Laboratory, Materials Research Laboratory, Surveillance Research Laboratory and Weapon System Research Laboratory. Advanced Engineering Laboratory was redistributed into the other Laboratories. ARL and MRL were predominately in Melbourne whereas the remaining Laboratories were in Salisbury. *Defence Report 1987–88*, pp. 40–41.

³¹² Slatyer, *The Defence Science and Technology Organisation and National Objectives: A report to the Prime Minister by the Australian Science and Technology Council (ASTEC)*.

assistance to non-defence companies 'as necessary in the national interest'.³¹³ DSTO was directed to pass full-scale engineering development work to industry resulting in the disbanding of Advanced Engineering Laboratories. In order to 'maintain a broad technology base' particularly in selected areas of high defence priority such as surveillance, over the horizon radar, command and control, DSTO was to 'devote more of its resources to research and exploratory development'.³¹⁴ Industry interaction was strongly pushed during this period and commercialisation ventures were encouraged.³¹⁵

In 1994, Electronic and Surveillance Research Laboratory in Salisbury was formed and this led to new divisions such as Information Technology, Communications, Surveillance Systems and Electronic Warfare Divisions and in Melbourne, ARL and MRL merged.³¹⁶ The change of structure reflected not only the desire for organisational efficiency but also the shift in emphasis to the electronic and surveillance focus of the White Papers—a precursor for the RMA.³¹⁷

Further to the Tange Report, a significant structural change occurred with the Defence re-organisation. With the movement of the Chief Scientist into Defence the service chiefs had a direct link into the DSTO and therefore the research programs.³¹⁸ Prior to the 1990s, the literature did not show a clear mapping of the defence science and technology research programs to defence policy.³¹⁹ The laboratory annual reports were a technical summary of

³¹³ *Defence Report 1987–88*, p. 40.

³¹⁴ *Defence Report 1987–88*, p. 40.

³¹⁵ A number of commercialisation projects were noted at this time including the agreements with various State government innovation centres. *Defence Report 1987–88*, p. 41.

³¹⁶ The combined laboratory was called the Aeronautical and Maritime Research Laboratory. This again reflected the growing influence of, and responsiveness to, the individual services.

³¹⁷ Prior to this change, it could be argued that the roots of the Salisbury laboratories lay in the Joint Project and this resulted in a less mature relationship with the Australian Defence Forces. Salisbury eventually became involved with the major development projects which 'directed a significant proportion' of resources to RAAF interests. Projects included Karinga, a bomblet scattering weapon, Barra, a sonobuoy and Jindalee. Wisdom, *A History of Defence Science*, pp. 155–63. These projects were predominately RAAF driven or focused and are indicative of the RAAF's generally higher use of technology. The other services could be argued to be less technically savvy at using the resources of DSTO—Army and Navy. See Wisdom, *A History of Defence Science*, p. 204.

³¹⁸ The position was now referred to as the Chief Defence Scientist.

³¹⁹ The Aeronautical Research Laboratory Annual Reports go back to near the time of its inception. The Salisbury laboratories did not appear to produce publicly available reports until WRE started producing reports in 1966–67. When DSTO was formed in 1974, Annual Reports were issued but the various laboratories stopped producing them around 1991.

the various laboratories, on a discipline-by-discipline basis and only provided broad trends.³²⁰ In 1989, ARL acknowledged for the first time, the impact of external influences.³²¹ Similarly, in the Science and Technology chapters of the Defence Reports of the time it was not until 1991–1992 that direct reference was made about ‘the responsiveness of the [DSTO] to identified strategic priorities such as those detailed in the 1987 White Paper and the Force Structure Review’.³²² The period is noteworthy in that it marks the time DSTO publicly began to respond to Defence policy.

By the late 1990s, DSTO had become an integral part of the Defence Department.³²³ The various reviews conducted during this time led to a range of changes that saw an increased focus on using science and technology to solve operational problems. The dominance of the technically advanced services, the Air Force and Navy, was altered when in mid-1997 Land Operations Division was formed. The division was ‘dedicated entirely to the

³²⁰ Using the Aeronautical Research Laboratory as an example, the move from basic physics research including fluid dynamics and hypersonic aerodynamics to applied research, such as operational modelling and fatigue testing can be noted from the mid 1960s to the early 1990s. For example in 1966–67, much work was done in support of government aircraft and munition factories projects, as well as civil aviation authorities, particularly in materials and accident investigation. No reference was made to broad strategic policy; nor was it expected to be made, given the style of the annual reports and the emerging connection to Defence. By the early 1990s the ARL research was still predominantly in support of the RAAF and two examples used refer the ‘response to a clear cut RAAF need’. Commonwealth of Australia, Department of Defence, *Aeronautical Research Laboratory Annual Report 1990–1991*, AGPS, Melbourne, 1991, p. 9.

³²¹ In an Annual Report, the Program Evaluation of ARL and the ASTEC review were noted, and in particular the poor exploitation of scientific output by Australian industry. Commonwealth of Australia, Department of Defence, *Aeronautical Research Laboratory Annual Report 1989–1990*, AGPS, Melbourne, 1990, p. 5. By 1991, broader defence reviews were noted and the impact of the Force Structure Review was discussed. *Aeronautical Research Laboratory Annual Report 1990–1991*, p. 10.

³²² *Defence Report 1991–1992*, p. 133.

³²³ In 1997–1998, explicit performance measures were stated in the Defence Report for the first time and DSTO’s performance measured against these. Performance measures included, the meeting of clients needs, identification and exploitation of emerging technologies, interactions with industry, increased interaction with regional countries, interactions that contributed to alliance relationships and decrease in the resources allocated to support activities. *Defence Annual Report 1997–1998*, p. 260.

technological and scientific needs of Army'.³²⁴ As part of the re-alignment of DSTO with the Service organisations, reviews into defence organisations saw a transfer of 'engineering' work to industry.³²⁵

In 2000, a new organisational structure of the Department of Defence was implemented that split the department into three 'Executives',³²⁶ each with their own, and disparate responsibilities.³²⁷ As part of this restructuring a new 'procurement' organisation, the Defence Material Organisation (DMO), was created to give an increased emphasis to fiscal management of defence acquisition programs and through life support. As a result, DSTO was required to provide more advice to DMO on the adequacy of scientific and technological proposals for new major capital investment. The increased focus for DSTO on solving operational problems and supporting the defence procurement organisation, DMO, which is focused on acquisition time cycles, has not been without its detractors. The balance between short-term problem solving versus long term scientific support is again raised.³²⁸

³²⁴ Land Operations Division Brochure, CC09805-14 (DSTO Corporate Communications, approximately May 1998). For elaboration on the formation of a Land Operations Division see 'Army march in creates strategic presence at DSTO', *Australian Defence Report*, Vol.11, No. 14, 3 August 2000, p. 11. At the same time, Maritime Operations Division was formed. The Navy relationship was more mature than Army, as indicated by the division dedicated to Navy ships, Maritime Platforms Division.

³²⁵ For example, the RAAF examined their future requirements for engineering. For elaboration see J.B. Macnaughtan, *Blueprint 2020: Engineering the Future*, Defence Publications, Canberra, 1993. As a result there had been a significant reduction in military engineering positions. This has arguably led to some DSTO research transferring to the more mundane engineering activities such as airframe fatigue testing. Further reductions were signalled in the 1997 Defence Efficiency Review. In this review core and non-core activities were examined and as a result there has been arguably a loss of technical skills in the military because of the increased emphasis on 'the sharp end'. For elaboration on the DER see McIntosh, *Future Directions for the Management of Australia's Defence: Report of the Defence Efficiency Review*.

³²⁶ The re-organisation in June 2000 was significant because a new organisation structure was created under the banner of the Defence Renewal Program. The 'business' model grouped the Air Force Army, Navy and Strategy together in an 'output executive', the Defence Intelligence Organisation and the Defence Material Organisation in an 'enabling executive' and the Inspector-General, Vice Chief of Defence Force and the Chief Finance Officer were in an 'owner support executive'. DSTO was originally in the 'enabling executive' but due to a range of concerns it was moved to the 'owner support executive' in 2001, *DSTO Connections*, 51, August 2001, p. 8.

³²⁷ Thomas, 'DSTO set to struggle on through shifting allegiances', pp. 8, 13.

³²⁸ The service chiefs appear to be aware of using DSTO for short-term gains to the detriment of a viable, potentially high pay-off longer-term research program. For example in October 2000, at a Chief Defence Scientist—Chief of Navy Conference, the Acting Chief Defence Scientist raised the issue of a greater move to strategic research. The Navy articulated a plan with a 30 year horizon. David Arnott, 'Shifting to a long perspective with Naval science', *Australian Defence Science*, Vol. 8, No. 4, 2000, pp. 12-13.

DSTO's External Defence Interactions

Australian defence and defence science has long been involved in a number of bilateral and multilateral activities. The benefits of collaborative activity are based on the exchange of technical data to maintain currency and a broadening of perspective, as well as achieving efficiencies by sharing risk, spreading costs and avoiding duplication. The links were predominately with the UK but have gradually shifted to the US as the alliance matured. The decline of the Commonwealth as an international body and the continual disputes between Pakistan and India gradually led to the demise of CAARC in 1993. The bi-lateral Anglo–Australian Memorandum of Understanding on Research (AAMOUR) was re-invigorated as a result but it has failed to establish the same levels of co-operation.³²⁹

In 1965 Australia was invited to join the US, UK and Canada in the US Non-Atomic Military Research and Development (NAMRAD) program called include The Technical Cooperation Panel (TTCP).³³⁰ On 25 October 1957, the President of the US and the Prime Minister of Great Britain made a Declaration of Common Purpose stating:

The arrangements which the nations of the free world have made for collective defense and mutual help are based on the recognition that the concept of national self sufficiency is now out of date. The countries of the free world are interdependent and only in genuine partnership, by combining their resources and sharing tasks in many fields, can progress and safety be found. For our part we have agreed that our two countries will henceforth act in accordance with this principle.³³¹

³²⁹ The AAMOUR MOU is a Cooperative Defence Research agreement was first signed on 7 July 1986 and again in 1995. The agreements have a life of 10 years. Private correspondence from the Counsellor of Defence Science (London) indicates that the first signing occurred in 1978.

³³⁰ TTCP was established in 1957 with the US, Canada and UK the original participants. New Zealand joined in 1969.

³³¹ Also included in the Declaration, was a decision to form two separate Subcommittees, one to concentrate on atomic energy and the other non-atomic research—the current TTCP. The declaration stated:

'As a result, an exchange of notes was made which reconstituted the Combined Policy Committee (CPC) that comprised the Foreign and Defense Ministers of the United States, the United Kingdom and Canada and also the heads of the atomic energy agencies of the three nations. It was further decided that two Subcommittees of the CPC should be established: one to deal with matters in the atomic field and the other to facilitate cooperation in non-atomic research and development.' <http://www.dtic.mil/ttcp> , accessed 21 August 2001.

The TTCP program has arguably given Australia access to a range of US research areas previously unavailable.³³² The shift to procurement and interoperability with US defence equipment further increase the utility of the program. The importance of TTCP to the US may be questioned, but it is notable that the US is not involved in defence science and technology with nations other than those in NATO and TTCP.³³³

DSTO is involved in a range of other Memoranda of Understanding, both civil and military, and a number of bilateral agreements, some of which fall under the Defence Cooperation program. These later agreements are essentially aimed at strengthening regional ties and security.³³⁴ The benefit of these external agreements is unquestionable because of Australia's limited resources and technology base. Yet, some agreements do not necessarily appear to be in line with Australian defence policy. For example, in 1994–95 the US Ballistic Missile Defense Organisation (BMDO) and DSTO signed an agreement on the conduct of cooperative research activities.³³⁵ While Australia has an interest in the areas of cooperation (sensors and surveillance)

³³² Groups in TTCP cover the following Technology Areas; Aerospace Systems, Chemical Defence, Communications, Command, Control, Computing and Information Systems, Electronic Warfare, Human Resources and Performance, Joint Systems and Analysis, Maritime Systems, Materials, Sensors, Conventional Weapons. TTCP now operates under a Memorandum of Understanding signed in 1995. <http://www.dtic.mil/ttcp>, accessed 21 August 2001.

³³³ The strength of the US commitment was tested when the UK privatised much of its military research and development. Issues of intellectual property transfer were raised and while the issues at the time appeared insurmountable a solution was found as both the UK and the US saw benefit in maintaining TTCP. Australia can participate in the NATO Research and Technology Organization (RTO) technical programme at the invitation of a NATO nation. For details on US involvement with external defence science organisations see Gansler and Etter, 'Defense Wide Research and Development'.

³³⁴ Memorandum of Arrangements between the Government of the Commonwealth of Australia and the Government of the United Kingdom and Northern Ireland on Co-Operation in Government Quality Assurance Of Defence Materials and Services entered in effect 25/11/77; concerning Cooperative Defence Research (AAMOUR) entered into effect 07/07/86; on Co-operation in Defence Equipment Development, Production and Procurement entered into effect 31/05/88. <http://www.dao.defence.gov.au/ipi/EIP/publications/COUNTRBK/ukcount4.htm>, accessed 22 May 2001. DSTO is involved a number of multilateral activities, but these are 'essentially driven by the Navy, Army and Air Force and aim to standardise the equipment of member nations and ensure that there will be the minimum of operational, materiel and technical obstacles to combined operations'. Examples are: **Navy**—America, Britain, Canada and Australia (ABCA) and America, Britain, Canada, Australia and New Zealand (ABCANZ) Information Exchange Projects; **Army**—Quadripartite Working Groups (QWGs); **Air Force**—Air Standardisation Co-ordination Committee (ASCC).

³³⁵ The cooperative research agreement is on ballistic missile detection and early warning. The research fields covered included 'surveillance, data fusion, communications, command support systems, and advanced air defence systems' not ballistic missile defence *per se*. On this point, see David Cartwright, 'Research into ballistic missile defence', *Australian Defence Science News*, 16, 1997, p.12

the umbrella of the BMDO would appear to imply Australian interest in a capability that has previously not been discussed, at least publicly. The thinning out of Australia's science and technology to areas not in the direct strategic interest is reminiscent of the influence the UK had under the joint agreement. The response to US requests to cooperate can arguably be seen as an unwanted by-product of an alliance where Australia is the junior partner.

DSTO and Industry Relationship

The original defence industry of Australia was a mixture of government and private facilities for supplies such as munitions and uniforms.³³⁶ As Ross states, '[b]y 1940, Australia had all the industries normally associated at that time with an industrialised economy.'³³⁷ This led to a very high level of self-containment.³³⁸ These major Australian manufacturing industry capabilities were cultivated because of the specific national development needs, i.e. the automotive and aircraft industry, and then diverted to support the war effort. After the war there was an excess capacity and during this transitory period the various laboratories were generally engaged in a wide variety of activities ranging from rocketry to metallurgical research. During the 1960s a number of defence companies merged but usually within national boundaries. The Cold War and the unconnected growth of the civil airliner market³³⁹ saw the development of a large number of support or supply companies, many in specialist areas, but the Australian defence industry was still small by international standards. At the time of DSTO's formation in 1974, the relationship between DSTO and industry was less strong because of a number of factors. These included the expanded range of DSTO activities, the lack of large Australian defence industrial companies, and the emphasis on basic research.³⁴⁰

³³⁶ These industries contributed to the development of secondary industry in Australia.

³³⁷ Andrew Ross, 'The Rise of Australian Defence Industry and Science 1901–1945'; Frank Cain, (ed.), *Arming the Nation: a history of defence science and technology in Australia*, Australian Defence Studies Centre, ADFA, Canberra, 1999, p. 28.

³³⁸ Self-containment is defined as containing in itself all that is necessary.

³³⁹ The growth was stimulated by the introduction of the jet airliner and the resultant reduction in passenger seat costs per kilometre travelled.

³⁴⁰ For elaboration of the breadth of activities and the research emphasis see annual reports of the time. Commonwealth of Australia, Department of Defence, *Aeronautical Research Laboratories Annual Report 1974–1975*, ADSS, Melbourne, 1975; *Material Research Laboratories Annual Report 1974–1975*; Commonwealth of Australia, Department of Defence, *Advanced Engineering Laboratories 1978–79*, DSTO, Adelaide, 1979.

Again, the aircraft industry is used to illustrate the changes to the relationship between industry and DSTO. After the Second World War the industry flourished with a number of aircraft designed and manufactured in Australia. This period lasted up until the 1970s. The procurement cycle resulted in a void for airframe manufacturers and generally the global industry was faced with the 'fact that there [were] a smaller number of more reliable aircraft with more durable engines that have stayed in service longer.'³⁴¹ During this time the viability of the three Australian airframe manufacturers was brought into question. Licence manufacture of military aircraft kept the airframe manufacturers in business, but this was at a cost premium. The Nomad development in the early 1970s was to be the last major complete airframe project. The CAC and Hawker de Havilland were reduced to engine or component manufacture, much of which was performed under the offset program. Some aerodynamic and structural testing was performed at ARL due to its unique facilities, but generally little was being done for industry.³⁴² The interesting aspect of this relationship was that DSTO was providing a technical service rather than research and more importantly long-term alliances between industry and DSTO did not appear as a result.

In order to boost Australian industry, the Department of Industry, Science and Resources developed the Cooperative Research Centre (CRC) Program in 1990. The centres brought together academia, industry and government research organisations such as DSTO and CSIRO.³⁴³ In 2000, Defence was involved in twelve CRC in fields including sensor, signal and information processing, polymers and advanced composite structures.³⁴⁴ The development of dual use technologies is seen as a fundamental way to maintain self-reliance. As an example, the CRC for Advanced Composite Structures built on industry and DSTO expertise in composite repair technology, which is an essential element of battlefield and depot level repair.

³⁴¹ Peter Smith, 'Australia's Aerospace Industry and Defence: A Brief History', p. 75.

³⁴² The offset program was used to support the local manufacturers when foreign civil and defence aircraft purchases were made. The foreign manufacturers were to provide the Australian manufacturers with opportunities to bid for components or sub-assemblies, with volumes beyond the local requirements to enable efficiencies. Subsidies were not generally payable. The offset program was viewed as success in that it enabled manufacturing industry to continue while the defence sector developed new projects such as the F/A-18 licence build in the early 1980s. During this time, significant civil offset manufacturing was being performed and this work helped level out the peaks and troughs of defence work. Smith, 'Australia's Aerospace Industry and Defence', p. 69.

³⁴³ For details on the formation of the CRCs see www.isr.gov.au/science/crc/index.html, accessed 10 December 2001.

³⁴⁴ Using the aerospace industry as an example, the CRC for Advanced Composite Structures is engaged in the development of design and manufacturing techniques using composites for both aerospace and non-aerospace applications.

Other links have developed including industry alliances, licences for technology, collaborative agreements and research agreements. They have all grown from a low base in the mid-1970s rising to significant contributions in the early 1990s to around 10% of DSTO's budget in the late 1990s.³⁴⁵ The 1992 Price Report³⁴⁶ encouraged the creation of 'commercial "strategic" alliances' with DSTO, increased commercialisation and the removal of the 1% limit on non-Defence work.³⁴⁷ Advantages to DSTO included the expansion of the national infrastructure from which it can source defence relevant expertise, a sharing of risk and influence on external research programs. In 1998 a new Strategic Policy for Defence Industry was delivered, partially in response to the DER and also because of a lack of progress on improving defence industry as identified in the Price Report.³⁴⁸ Again DSTO was identified as having an increased role in the process of transferring the intellectual property to industry, both to prime contractors and the multitude of small to medium enterprises (SME), in the defence sector.³⁴⁹

Both government and industry have encouraged the need for improvement in DSTO and industry relationships,³⁵⁰ but industry criticised DSTO for not building on its successes. DSTO had a strong role in the instigation,

³⁴⁵ In 1976 the Defence Report did not list any external agreements outside of TTCP. In the 1991–92 Report, the CRC and Telecom Research interactions were noted as well as \$900,000 invested in basic research at Universities and \$1.3m for university research with 'deliverables' and \$3m worth of Australian industry technical support. In 1998–99, DSTO had 12 Research Agreements, 26 Collaborative agreements, 64 licences, 18 Industry Alliances, participation in 9 CRCs and 5 MOUs. \$23m was spent outsourcing research and development and technical support to industry and other external agencies. From Commonwealth of Australia, Department of Defence, *Defence Report 1976*, AGPS, Canberra, 1977 and *Defence Report 1991–1992, 1998–1999*.

³⁴⁶ Price, *Defence Policy and Industry*.

³⁴⁷ Tony Tabrett, 'Review—Greater Scope for DSTO Industry Links', *Australian Defence Magazine*, Vol. 2, No. 6, August 1994, p. 24.

³⁴⁸ *Australian Defence Business Review*, Vol. 17, No. 9, 12 June 1998, p. 20.

³⁴⁹ At the time there was active encouragement for the formation of SMEs, see *Australian Defence Business Review*, Vol. 17, No. 9, 12 June 1998, pp. 19–21.

³⁵⁰ The ubiquitous calls for increased DSTO and industry interaction include all White Papers since the DSTO Internal and External Reviews in 1980. Others include the Inspectors General report into, inter alia, Jindalee, F.R. Harvey, Department of Defence, Inspector General Division, *Communications and Development Projects Sub-Program—Program Evaluation—(Program Development and Communications Division)*, Departmental Publications, Canberra, September 1992, p. ii, and in an interview with the Chief Defence Scientist, Ian Chessell, 'From the Source', *Australian Defence Magazine*, Vol. 9, No. 5, May 2001, pp. 37–38.

development and testing of the GAF-built guided weapons systems Jindivik and Ikara and the sonar technology based Mulloka and Barra.³⁵¹ None of these projects have spawned follow-on products. Industry has requested 'greater research discipline' which would provide 'greater continuity in fewer research technologies' which they argue would benefit both defence and industry.³⁵² DSTO's role is clearly not a product developer but the industry view that DSTO has continually expanded its areas of interest to reflect the increased technologies in the ADF appears at odds with the ADF's requirements for DSTO input. It must be noted that industry itself has generally not invested heavily in its own research and development.³⁵³

Again, an element of the principle of self-reliance related to industry for defence whose capacity is limited to the extent 'necessary for the effectiveness and sustainability in combat' of the ADF.³⁵⁴ If the development of an industry for defence is the primary aim, the evidence suggests that the relationship between industry and DSTO has not kept up with the policy directives. New alliances are continually being signed but the continual reiteration of increasing industry and DSTO linkages and alliances indicates little success.

³⁵¹ At their time of development all these systems were world-class and arguably ahead of similar systems.

³⁵² Hector Donohue, 'Industry Forum', Proceedings of the RUSI International Seminar—Seeking Affordable Defence in the 21st Century, *Journal of the Royal United Services Institute of Australia*, 22, December 2000, p. 82.

³⁵³ The aerospace industry does not publish data on research and development spending. However, there is no evidence by way of facilities or staffing to indicate the contrary. However, the CRC for Advanced Composite Structures is one visible industry wide research 'facility' based physically inside AMRL, Fishermans Bend.

³⁵⁴ Dibb Review, p. 107.

CHAPTER 5 DSTO INPUT INTO DEFENCE PROGRAMS—CASE STUDIES

The preceding chapters have demonstrated that DSTO aligned its research program with Defence policy since the Dibb Review under the guiding principle of self-reliance. In parallel there have been repeated calls for increased DSTO and industry interaction with aims as broad as increasing both self-reliance and national wealth. Two Australian defence projects, JORN over-the-horizon radar and the Collins-class submarine, are evaluated for their contribution to Australia's self-reliance. The effects of external influences such as the RMA and global trends are also examined to see if they enhance or detract from the goal of self-reliance.³⁵⁵

Jindalee Over the Horizon Radar

Background

British research just prior to the Second World War led to the Home Chain radar system that demonstrated the usefulness of radar systems to track targets. During the embryonic radar experiments, signals were bounced off the ionosphere, and as a result they travelled much longer distances than line of sight radar. At the time these long-range signals were seen as a nuisance, but the notion of extending the range of radar was not lost on researchers.³⁵⁶ The ionosphere was notoriously unstable and in the early 1950s, scientists at Salisbury's Electronic Research Division were engaged in research to determine the stability, as the magnitude was unknown over Australia's north. The initial research focused on measurements to characterize the behaviour,³⁵⁷ and given Australia's large area of interest, the utilisation of the

³⁵⁵ Rapidly changing technologies that underpin these phenomena may further reduce the ability of Australia to adhere to the principle of self-reliance. The historical development of DSTO from ARL and WRE also demonstrates the difficulty in adapting the organisation to faster changing drivers. The business and military decision cycle times are being driven downward and this further indicates difficulties for organizations that have been traditionally slow to react.

³⁵⁶ Research was being undertaken in the UK and also at the US Naval Research Laboratory where ionospheric propagation was being investigated. Don Sinnott, *The Development of Over-The-Horizon Radar in Australia*, AGPS Press, Canberra, undated but released as a 1988 *Bicentennial Monograph*, p. 3.

³⁵⁷ The background research into the ionosphere was driven by general research, such as frequency management to optimise ionosphere radar wave propagation through to requirements to improve long range radio communications between Australia and the northern hemisphere. Wisdom, *A History of Defence Science*, p. 191. It appears that the first reference to the ionospheric research was in the 1967–68 Annual Report where 'trans-equatorial radiowave propagation' research was noted. By 1970–71, the research had progressed to the point where equipment was installed at Yamagawa in southern Japan. Commonwealth of Australia, Department of Supply, *Weapons Research Establishment Annual Report 1967–68*, Salisbury: WRE, 1968; Commonwealth of Australia, Department of Supply, *Weapons Research Establishment Annual Report 1970–71*, AGPS, 1972, pp. 11–12.

ionosphere for over the horizon radar was readily appreciated.³⁵⁸ The measurements were conducted at Woomera using results collected from Black Knight rocket firings conducted under the Joint Project. Use was made of the UK-initiated vertical firing of the rockets to study the physics of re-entry bodies by way of measurements of the atmosphere and the rocket and plume. The tests were quite remote from Australia's defence interests, but they did provide an entrée into high technology industries of which space was seen as a leader.³⁵⁹ At the time of the Black Knight launches 'UK authorities suggested that the opportunity might be taken to carry out some measurements on the "radar echoing area of rocket flames" as a study separate from the reentry measurements'.³⁶⁰ High-level classified research followed but during this time the elements of a future OTHR were being assembled and understood.³⁶¹

Australia's nascent OTHR experiments were substantial and significant enough to gain access to US research in critical areas such as signal processing and computing.³⁶² Defence scientists made submissions to the Chief Defence Scientist indicating the potential of ionospheric radar for Australia. By November 1970 a research program commenced with the aim of deciding if the use of ionospheric radar systems could provide 'continuous uninterrupted surveillance of aircraft movements at long range'.³⁶³ The tracking of ships was more challenging but the background basic research identified possible solutions.³⁶⁴ The research progressed in a number of

³⁵⁸ For a more complete history of Australian Over The Horizon Radar research, see Sinnott, *The Development of Over-The-Horizon Radar in Australia*; Morton, *Fire Across the Desert: Woomeras and the Anglo-Australian Joint Project*; Wisdom, *A History of Defence Science*, p. 157–60.

³⁵⁹ Australia was also a member of the European Launcher Development Organisation (emphasis added) and provided launch facilities to multi-stage rockets including Europa I. Commonwealth of Australia, Department of Supply, *Weapons Research Establishment Annual 1966–67*, Adelaide: WRE, 1967, pp. 15–16.

³⁶⁰ Sinnott, *The Development of Over-The-Horizon Radar in Australia*, p. 4.

³⁶¹ A most unexpected 'bloom ... in the radar echo' was discovered as the rocket left the earth's atmosphere and this had implications for detection of ICBM launches. It took several years to explain the observed phenomena. Sinnott, *The Development of Over-The-Horizon Radar in Australia*, p. 5.

³⁶² Under the auspices of the TTCP panel dealing with Radar Techniques. Wisdom, *A History of Defence Science*, pp. 158–59.

³⁶³ Wisdom, *A History of Defence Science*, p. 158.

³⁶⁴ The ability to use Doppler to separate radar returns was one necessary element developed during these tests. The Black Knight rocket firings continued to around 1964 and then the ELDO firings of Blue Streak commenced. These firings were 'intermediate-range ballistic trajectory[ies]' and presented opportunities to develop the techniques over longer ranges. Sinnott, *The Development of Over-The-Horizon Radar in Australia*, pp. 6–8; Wisdom, *A History of Defence Science*, p. 191.

phases; in 1970 the Geebung program involved an OTHR study and measurements. After a pilot radar was developed in 1975 Jindalee quickly progressed to where a working system was demonstrated in 1978.³⁶⁵

Strategic context

The primacy of a surveillance capability of the northern sea and air approaches has been evident since the attacks on Darwin and Broome in 1942. The protection of the enduring feature of Australia's geography, the sea and air gap, is one of the prime defence strategies that has been articulated since the early 1970s.³⁶⁶ The early development of the technologies that contributed to Jindalee predates any articulated strategic guidance for this capability.³⁶⁷ During these years the Cold War and the myriad of events affecting the former colonial states such as Malaya and Vietnam appeared to dominate defence policy.³⁶⁸ The Joint Project provided many opportunities for researchers in a range of civil and defence areas and JORN's predecessor were able to make use of these opportunities. Significantly, during these times there was little outside influence and also an acceptance of the notion that scientific curiosity was an adequate justification for research.³⁶⁹ The amalgamation of defence in the 1970s and the increased alignment of the scientific laboratories with the services altered this loose relationship between Defence and DSTO.

³⁶⁵ The project has had a number of names and JORN is used for generic references in this monograph. The amalgamation of the technologies to detect targets was conducted in program Geebung. The Geebung experiments were followed by a pilot radar, Jindalee Stage A, and in Jindalee Stage B, all the attributes of a working system were demonstrated. The Jindalee Operational Radar Network is, as the name suggests, the operational version.

³⁶⁶ Australia's military strategy has evolved and in the 2000 White Paper, it is based on the priority task of the Defence of Australia. The approach to this is shaped by three principles—self-reliance, control of the sea and air gap by way of a maritime strategy and attacking enemy forces as far from Australia as possible pro-active operations. See also 2000 White Paper, p. xi.

³⁶⁷ In the 1976 White Paper the only references to Project Jindalee were in the context of research investigations, the sea and air gap is alluded to in the discussion of 'enduring feature in our physical environment', 1976 White Paper, p. 13.

³⁶⁸ Commonwealth of Australia, *Defence Report 1964*, Canberra, 1964, p. 5, through to Commonwealth of Australia, Department of Defence, *Defence Report 1972*, AGPS, Canberra, 1972, pp. 3–4.

³⁶⁹ Sinnott in his history of Jindalee noted that 'many of the bureaucratic shackles which came with a mature Research and Development organisation answerable to Service Customers had yet to exert their influence', Sinnott, *The Development of Over-The-Horizon Radar in Australia*, p.1.

The strategic implications of the project emerged as a trial radar was eventually demonstrated in 1978. By the time of the Dibb Review, the OTHR research had indicated that the concept was feasible for the Australian environment.³⁷⁰ Dibb's 'strategy of denial' required surveillance and intelligence and the OTHR, airborne early warning and long-range maritime patrol were complementary activities that provided this capability.³⁷¹

The formalisation of OTHR in the Dibb Review indicated the growing acceptance by the defence hierarchy of the capability, notwithstanding the long and difficult gestation period. While, the Defence Department sponsored the initial investigations, the Air Force is acknowledged as the prime proponent of the surveillance requirement. They had a continuing interest and technical appreciation of the potential outcome of the research, particularly its efficacy compared to airborne early warning radar.³⁷² In order to gain support, various dignitaries, including the Secretary of Defence and Chief of Air Staff were taken to the trial sites and the successful demonstrations of the OTHR capability led to a slow shift in support of the concept. It is argued that the background research for OTHR in Australia was driven initially by the innate interest in the scientific challenges offered by the ionospheric research. The program appears to have been put into a broad defence strategic context, that is sea and air gap, after the 'proof-of-concept' was demonstrated. In the development period, DSTO's role in articulating the strategic context of OTHR is not clear, other than positing the ubiquitous notion of self-reliance or independence. The initial lack of an operational requirement increased the difficulty in advocating JORN. Also, the long development period, and at times, serendipitous nature of scientific research, did not mesh well with the more rigid capability development process of Defence.³⁷³

³⁷⁰ It was stated that a senior defence civilian (DEPSEC B) put the upgrade on hold during the writing of the Dibb Review. A full-scale operation system was proposed rather than an incremental upgrade. Dr. R.K. Jarrott, *Jindalee OTH Radar Network*, Telecom Jindalee Project, T2010, Clayton, Victoria: Telecom, undated but approximately 1992, p. 5.

³⁷¹ Dibb Review, pp. 61–62.

³⁷² Wisdom, *A History of Defence Science*, p. 212.

³⁷³ It has been argued from within DSTO that the lack of high-level support in the initial phases performed a filtering process, in effect weeding out less satisfactory developments.

The project illustrates that the principle of self-reliance is only effective within an alliance framework. On a strategic level, the JORN is one element in a suite of US and Australian surveillance sensors. On the science and technology level, the UK input to the original research that explored the ionosphere was to prove critical and the US support to the project during the developmental stages was similarly essential. In the former case the rocket sounding tests conducted under the UK-initiated Joint Project and in the latter case the access to US technology under TTCP collaboration was then used to augment and develop the research.³⁷⁴

Industry

JORN is the largest project that has transitioned from a DSTO research program into an industry project. Little industry support or interaction was available in the early stages. The demonstration system was developed using borrowed US equipment and in-house support that pushed Australian technology to new levels. The Salisbury laboratories were at the forefront of many technology areas in Australia at the time; industry was gradually used in specialist areas.³⁷⁵ The technology required for Jindalee was 'so far removed from the experience of Australian research workers', longer lead times were encountered in bringing technology to maturity.³⁷⁶ Jindalee was built on the experience gained in a number of other projects including signal-processing techniques developed for the Barra sonobuoy. Additional resources were put into these areas of expertise and the formation of a CRC for signal processing augmented DSTO efforts with industry, academia and defence.³⁷⁷

³⁷⁴ By 1966–67, the US was conducting the Sparta Project at Woomera. Radar and radiation phenomena induced on the re-entry of bodies into the atmosphere were observed. A parallel re-entry physics research program was conducted by WRE into the brightness history of the re-entry of various bodies into the earth's atmosphere. *Weapons Research Establishment Annual Report 1966–67*, pp. 15–16. The Joint US–Australia Dazzle and Sparta trials results were being presented in the US to a TTCP meeting and in an attempt to stimulate interest in the ionospheric research the WRE re-entry results were also presented. Sinnott, *The Development of Over-The-Horizon Radar in Australia*, pp. 9–10.

³⁷⁵ As an example, the generators and the antennae were built by local industry. But there is no evidence to suggest that significant new industries were spawned out of the project, other than the prime contractor (itself an alliance of local and foreign companies).

³⁷⁶ Sinnott, *The Development of Over-The-Horizon Radar in Australia*, p. 12.

³⁷⁷ A number of centres of expertise were developed including that built on the CRC for Sensor Signal Information Processing (CSSIP). The technology driving much of JORN was based on efficient signal processing and these technologies are used from compact disc players through to defence systems such as Barra and JORN. See www.cssip.edu.au for details, accessed 10 December 2001.

When the approval of Jindalee Stage B came in May 1978, the workload was beyond DSTO's capabilities and industry was requested to 'design, commission and operate' the system.³⁷⁸ Amalgamated Wireless (Australasia) (AWA) won the bid and the ensuing contract was successful.³⁷⁹ The RAAF continued to lead the developmental push however plans to stimulate Australian industry enthusiasm and subsequent technology transfer did not eventuate.³⁸⁰ DSTO transferred the intellectual property and design experience to industry, while continuing research and development into OTHR.

The industry support to the evolving project will now be examined in more detail. A high local content was mandated but the Department wanted to mitigate the risk by stating that an Australian 'prime' could not perform the task alone.³⁸¹ Defence was grappling with the continual issue of developing the defence industry, particularly indigenous projects. As a result, Jindalee was transferred from Air Force Material Division to the newly formed Project Development and Communications (PDC) Division.³⁸² The Defence requirement was for a prime contractor to 'build JORN from scratch'. The bidding for the project was between AWA Defence Industries, with Lockheed Martin as a subcontractor,³⁸³ and Telecom with GEC-Marconi. In 1991 a contract was signed with Telecom and with a completion date of 1997.³⁸⁴

³⁷⁸ Often referred to as the 'Workhorse', Wisdom, *A History of Defence Science*, p. 160.

³⁷⁹ Wisdom, *A History of Defence Science*, p. 160.

³⁸⁰ In 1982, a number of study contracts were put up to stimulate interest in participating in Jindalee but other than conducting specific work, little entrepreneurial flair was forthcoming. Sinnott, *The Development of Over-The-Horizon Radar in Australia*, p. 30.

³⁸¹ The term 'prime' in the procurement field relates to the notion of prime contractor who then deals with a range of sub-contractors. For further details on the JORN arrangements see Jarrott, *Jindalee OTH Radar Network*, p. 8.

³⁸² In March 1988, the Secretary for Defence formed the Project Development and Communications Division within the then Capital Procurement Organisation, (soon to become the Acquisitions and Logistics Organisation and currently the Defence Material Organisation). The changes at the time were to enable 'greater business competence and management of major projects, more effective transition of indigenously developed systems ... and exports'. Jindalee and Nulka were seen as two projects requiring these management changes. Harvey, *Communications and Development Projects Sub-Program—Program Evaluation—(Program Development and Communications Division)*.

³⁸³ At the time Lockheed Martin (LM) was part of General Electric (GE) and later became Lockheed Martin Ocean Radar and Sensor Systems. A. W. Grazebrook, 'JORN—confidence for the next challenge', *Asia-Pacific Defence Reporter*, Vol. 15, No. 5, August–September 1999, p. 24.

³⁸⁴ The original telecom contract was of the order of \$970m. Jarrott, *Jindalee OTH Radar Network*, p. 8.

Perhaps naively, the surveillance system was seen to be within the bailiwick of a telecommunications company however scientists within DSTO saw Telecom's involvement with some incredibility.³⁸⁵ The PDC concern at the time appeared to be the desire in 'growing an Australian prime contractor'.³⁸⁶ DSTO's role had by this stage had changed 'to act as [R&D] authority and to maintain OTHR technology'.³⁸⁷ By 1992, the Inspector-General had investigated the PDC and inter alia, found it to be potentially deficient in managing an indigenous project 'given the significance and cost' of Jindalee.³⁸⁸ In 1994, Telecom rescheduled the completion date back two years to 1999 and considerable attention was then paid to program slippage and the declining relationship between Telecom and GEC-Marconi.³⁸⁹ However, the DSTO and industry interaction was still being touted as a success and Telecom was interested in developing other DSTO research.³⁹⁰ In 1996, the Auditor expressed concern as to how the Defence Department had let a high-risk development project to Telecom³⁹¹, given its inexperience in OTHR and large-scale defence systems.³⁹² In February 1997, the Minister for Defence announced that RLM³⁹³ was to provide project management³⁹⁴—Telecom had 'fluffed it' because for a number of reasons including its failure to develop a systematic test and evaluation strategy.³⁹⁵ By October 1998, the cost of JORN had risen from \$970m to \$1.7bn³⁹⁶ and RLM was still grappling with the complexities of the program.

³⁸⁵ Lockheed Martin had previously been involved in OTHR technology for the US Air Force. Grazebrook, 'JORN—confidence for the next challenge', p. 24.

³⁸⁶ Gregor Ferguson, 'Parliament Slams JORN Management', *Australian Defence Magazine*, Vol. 6, No. 4, April 1998, p. 4.

³⁸⁷ Sinnott, *The Development of Over-The-Horizon Radar in Australia*, p. 31.

³⁸⁸ Harvey, *Communications and Development Projects Sub-Program—Program Evaluation—(Program Development and Communications Division)*.

³⁸⁹ Max Hawkins, 'Concern Over Three Year JORN Delay', *Australian Aviation*, August 1996, p. 50.

³⁹⁰ *Australian Defence Magazine*, August 1994, p. 28.

³⁹¹ Telecom formed a subcontractor company for the software. Telstar (sic) was a 60:40 joint venture between Telecom Australia and Lockheed Missiles and Space Company. Telecom became Telstra soon after. *Australian Defence Magazine*, January 1995, p. 24.

³⁹² RLM was still legally subcontracting to Telstra. Max Hawkins, 'Concern Over Three Year JORN Delay', p. 50.

³⁹³ RLM Management Company was '50:50 joint venture of Lockheed Martin and the Tenix Group (formerly Transfield Defence Systems)'. RLM assumed full management responsibility in 1997. Commonwealth of Australia, 'Jindalee Operational Radar Network' in *DSTO and Industry Partnerships for Australia's Wealth and Security*, DSTO Brochure CC006/2001-117, DSTO, Canberra, 2001, p. 9.

³⁹⁴ Gregor Ferguson, 'Parliament Slams JORN Management', p. 4.

³⁹⁵ John Stackhouse, 'JORN—Australia's Surveillance Dream Begins to Finally Take Shape', *Australian Aviation*, December 1998, p. 28.

³⁹⁶ Stackhouse, 'JORN—Australia's Surveillance Dream Begins to Finally Take Shape', p. 27.

The JORN project was a difficult challenge for Defence management. The formation of a Project Development and Communications Division was seen as failure. The dearth of large indigenous, design, projects and the difficulties associated with the procurement of one-off system contributed to this failure.³⁹⁷ The inability of one of Australia's largest companies to manage JORN was not a good omen for future indigenous RMA technology projects. The use of RLM, with its knowledge of large-scale projects management and OTHR technology, indicates the practical difficulties in maintaining real independence.

Self-reliance

Using both the broad and narrow interpretations of self-reliance, JORN contributes to Australia's self-reliant defence posture because it has led to, inter alia, an independent surveillance and intelligence capability. When using the limited interpretation of self-reliance, JORN supports Australia in low and medium-scale conflict without external aid. JORN also enables Australia to perform a range of surveillance activities relating to non-traditional security threats such as illegal migration.³⁹⁸ While JORN has given Australia a level of independence the role of Australia's 'alliance' partners cannot be ignored. In the early days of the project, the work carried out under the UK-initiated Joint Project was fundamental in providing the basic building blocks that were assembled from a diverse range of projects including the early ionospheric research. The science and technology support was broad and the connection with existing disparate scientific programs cannot be underestimated. Then in the 1970s the US alliance played a vital role because material and intellectual support was given to DSTO. When leading edge technology was found wanting, US support was forthcoming. Again, self-reliance in the Australian context is only practicable when viewed in the context of the alliance. The usefulness of the alliance to augment truly independent activity may be interpreted as realism rather than any diminution of self-reliance. The project has led Australia into a position where it can contribute to elements of the RMA—perhaps more by serendipity than careful planning.

³⁹⁷ On 26 June 2001, the government's new 2001–2010 Defence Capability Plan was released. The difficulties in structuring local industry involvement were addressed, particularly in the aerospace environment compared to the aerospace environment. Trevor Thomas, 'Road ahead set by new defence capability plan', *Australian Defence Business Review*, Vol. 20, No. 10, 9 July 2001, p. 11.

³⁹⁸ For elaboration on these non-traditional threats see J. McFarlane and K. McLennan, *Transnational Crime: The New Security Paradigm*, Working Paper 294, SDSC, ANU, Canberra, May 1996.

From an industrial self-reliance perspective, the development of local industry has been less successful. The scientific support provided by DSTO has been an enduring feature of the program and the ability of DSTO to support the various industry contractors has not been questioned. The choice of Telstra was questioned within DSTO due to its status as a telephone company rather than a seasoned defence contractor.³⁹⁹ Industrial self-reliance, and the science and technology support and interaction, was enhanced by JORN but given the failure of the Telstra consortium, the gains are difficult to quantify. While the choice supported an Australian company, Telstra was still reliant on foreign input for large-scale defence systems engineering and project management.⁴⁰⁰ The global trend of mergers and reduced numbers of defence contractors is mirrored in the JORN project. JORN unarguably contributes to the RMA and in this case Australia's self-reliance status is enhanced. JORN is also indicative of the shift to the joint operations *modus operandi* of the ADF. It should be remembered that at the time of the development the OTHR was 'bitterly opposed' by the Service Chiefs; it foreshadowed the shift in the current joint nature of Defence.⁴⁰¹

Collins Submarine

Background

In 1984 the Hawke government delivered a new policy for the defence industry, which, along with the subsequent Dibb Review, argued for increased self-reliance. A number of significant decisions were then made that supported the indigenous defence industry.⁴⁰² The policy resulted in an unprecedented increase in Australian defence industry spending and the shipping industry was visibly the greatest beneficiary with the building in Australia of foreign-designed ANZAC frigates and Collins-class submarines.⁴⁰³

³⁹⁹ Private communications within DSTO.

⁴⁰⁰ A discussion of the merits of Australian versus foreign ownership is beyond the scope of this thesis. Nevertheless, it should be noted that 'multinationals are deeply tied to their home countries in corporate style, ownership and the production of their highest value components'. Peter Beinart, 'An Illusion for Our Time', *The New Republic*, 20 October 1997, p. 23. For elaboration on multinational company research and development issues, refer to Martin, *The Core Capacity of Australian Science and Technology*, pp. 3–4, 18–19, 32.

⁴⁰¹ Sinnott, *The Development of Over-The-Horizon Radar in Australia*, p. 17.

⁴⁰² 'In June 1984, the ministers for Defence and Defence Support announced principals which have been approved by Government for the development of defence policy for industry and its implementation.' The statement was reproduced in *Defence Report 1983–84*, pp. 57–58.

⁴⁰³ The aircraft industry also gained from significant work in assembling F/A-18 aircraft and Blackhawk and Seahawk helicopters. See Woodman, 'Exploding Myths: Defence Policy for Industry Beyond the Price Review', pp. 28–30.

The decision to replace the Oberon-class submarine fulfilled Beazley's first and second pillars of self-reliance. In supporting the first pillar, the submarine's strike and intelligence roles supported the primary task of the defence of Australia. In supporting the second pillar, the decision to locally produce a foreign design compared to purchasing a complete system albeit with local logistical support, including weapons, must be analysed. Was the decision based on the declared policy of defence self-reliance or was it a mix of defence policy and employment and industrial policy? Did DSTO develop expertise prior to the submarine announcement, one of the largest defence programs ever or did it simply react to issues as they arose?

Strategic context

Submarines provide a capability that contributes to a range of strategic tasks. These include the primary task of the defence of Australia by way of defending the sea and air gap and providing a buffer zone.⁴⁰⁴ The existing Oberon-class fleet provided some of this capability but the newer submarines have longer range and greater offensive and intelligence capabilities, all of which contribute to an increase in national capability.⁴⁰⁵ The decision to acquire the submarines was in many ways viewed as simply a replacement of an increasingly difficult to maintain weapon platform. The choice of builders was limited because of the US dependency on large nuclear-powered vessels.⁴⁰⁶ The cost and more importantly the politically destructive debate over the acquisition of a nuclear-powered vessel effectively ruled out this as a choice.

⁴⁰⁴ 2000 White Paper, pp. 46–47.

⁴⁰⁵ Ball refers to the unique and previously unfulfilled capabilities of the Collins. Desmond Ball, 'Australia's Info war architecture', p. 10. The Collins-class is required to carry out the following missions: Reconnaissance and intelligence gathering; Surveillance; Maritime strike; Mine-laying; Clandestine operations; and Anti-Submarine Warfare training for other ADF units. From McIntosh and Prescott, *Report to the Minister for Defence on the Collins Class Submarine and Related Matters*, pp. 29–30.

⁴⁰⁶ John Dikkenberg, 'Diesel electric submarines: a European perspective', *Asia-Pacific Defence Reporter*, October–November 2000, p.22.

Self-reliance

The indigenous manufacture of platforms contributes to defence industry capability directly and the broad principle of self-reliance. The indigenous manufacture of a major platform *per se* does not necessarily contribute to the more useful notion of limited self-reliance. The decision to build the submarine locally is examined against publicly articulated policy and the various elements of self-reliance. The longer-term goal of developing a sustainable Australian defence industry is also examined in the context of the submarine program.⁴⁰⁷

The period in which the Collins acquisition process commenced was notable for high unemployment and increasingly large current account deficits. The Labor government's solution to these problems was to 'pick winners' or generate large projects that would carry with them a range of national benefits. The 'winners' were based on a number of factors including the move to a technology-based economy, the support to existing manufacturing industries in a reduced tariff environment—automotive—but also the desire to create jobs was at the forefront of many decisions, particularly those in marginal seats. The approach was consistent with the Hawke (and Keating) Labor government's strong concerns for industry development due to their trade union based membership.⁴⁰⁸ As a result of this strategy, an increase in exports and a reduction in the current account deficit could have been expected. The projects chosen were usually high in local industry value and those with the greater potential to create jobs. There was a general assumption that there would be a significant flow down effect beside the high employment.

⁴⁰⁷ Woodman, 'Exploding Myths: Defence Policy for Industry Beyond the Price Review', pp. 28–30.

⁴⁰⁸ As noted previously, the Howard 'Government is not in the business of picking winners', instead it is looking to rationalise areas of industry to create a sustainable defence sector. Trevor Thomas, 'Reith positioning for a major defence-industry policy change', *Australian Defence Business Review*, Vol. 20, No. 12, 21 August 2001, p. 7.

The decision to build locally is obviously based on other factors than simply picking winners. An understanding of the prime factors is important as they may distort the strategic priorities. The notion that differences exist between declaratory and actual policy is an accepted part of the political process. The defence priorities must not be distorted by other national goals as they diminish the transparency of defence policy. The various factors that may contribute to defence goals include:

- Self-reliance—limited definition
- Maintenance of critical independent technology
- Protection of Intellectual Property

The broader interpretation of the industry element of self-reliance fitted into the more general government policy on increased industry competitiveness along with national prestige, foreign currency benefits, reduced unemployment and coupled with the Labor government's desire to increase the competitiveness of Australian industry in general.⁴⁰⁹ Arguably defence should not be encumbered with the premium incurred in locally manufacturing defence equipment if industry or social policy objectives such as employment prevail.⁴¹⁰ While national wealth building is an overall aim of increased security, decisions based on this must be articulated clearly as non-defence policy aims.

⁴⁰⁹ Woodman, 'Exploding Myths: Defence Policy for Industry Beyond the Price Review', pp. 28–30.

⁴¹⁰ The cost premiums for local production have varied over the defence programs. Markowski and Hall offer a figure of 17% for the F/A-18 production in Australia whereas they indicate that the JORN and ANZAC projects have had 'relatively modest' premiums. See also Markowski and Hall, *Defence Self-Reliance and Domestic Industry*, pp. 20–21.

Nevertheless, a decision was made to manufacture submarines in Australia. An existing submarine was not available to meet unique Australian requirements hence a larger version of an existing submarine was designed by the Swedish company, Kockums. The company had a history of building non-nuclear submarines. The Australian Submarine Corporation (ASC) was formed out of the Kockums, the Australian government and a range of local and foreign companies.⁴¹¹ A new site was chosen near Port Adelaide in South Australia for constructing the submarines.

The infrastructure costs for a 'green-field' site and the limited production run did not augur well for the development of a sustainable industry capability. The Minister for Defence in the latter part of 2000 began to address his concerns regarding the sustainability of the plethora of naval shipbuilding yards in Australia. The Navy's requirements over the next two decades should have been well developed given the long lead times in the procurement of major weapons systems such as naval platforms.⁴¹² Follow-on work was unclear⁴¹³ but very necessary to ensure survival of the ASC hence the decision

⁴¹¹ At the time of the signing of the contract for Collins, the Australian Submarine Corporation comprised Kockums Pacific (49%), Wormald (25%), the Australian Industry Development Corporation (AIDC) (25%), and CBI Constructors (20%). From *Defence Report 1987–88*, p. 23. The shareholding consolidated to AIDC (48.45%), Kockums Pacific (49%) and RCI (2.55%). Kockums Pacific parent, Kockums Sweden, designed the Collins Class Type 471 diesel-electric submarine. The submarines are substantially larger and longer than the rest of the world's diesel electric submarines (approximately 3300 tonnes dived weight, 78 meters long and 8 meters in diameter at the fin). The submarine's operational profiles are different to the nuclear powered 'attack' submarines and are more suited to the littoral rather than the ocean environment of the Cold War-design nuclear submarines. The submarine has a range of 11,500 miles at 10 knots surfaced. For additional information see McIntosh and Prescott, *Report to the Minister for Defence on the Collins Class Submarine and Related Matters*, <http://www.naval-technology.com/projects/collins/>, accessed 5 August 2001, and www.adi-limited.com.au/privatisation/priv_02.html, accessed 6 August 2001.

⁴¹² Given the long lead times for the development of a major capability this is not unreasonable.

⁴¹³ ASC efforts at export included an attempt to build and sell nine submarines to Singapore. Other external work was sought and as an example, in 2000 a contract to provide design and project management expertise for a Hong Kong patrol boat manufacturer www.theage.com.au/bus/20000810/A59596Aug9.html, accessed 6 August 2001. Once the submarines have been built it is not anticipated that a new procurement will be made for another 27 years, *Australian Defence Business Review*, 31 October 2001, p. 9.

by the Howard government in July 2001 to perform the maintenance in South Australia was welcomed.⁴¹⁴ Strategically the decision had little foundation. After the hulls had been fabricated, the facilities were not strictly necessary for on-going maintenance support and long distance to their operational base in Western Australia was an impediment for operations.⁴¹⁵ McIntosh and Prescott stated in 1999, 'there is no alternative from an efficiency perspective and from a submarine crewing perspective to most submarine and indeed refitting work in [WA]'.⁴¹⁶

However, the submarine project is 'Australia's most important strategic asset ... and [the] most ambitious and technically advanced defence industrial project ever'.⁴¹⁷ The Australian shipbuilding industry had never built such a technically advanced weapon platform nor did it have any experience with submarine building. Australian sub-contract support was obtained from a number of areas including the provision of submarine steel, hull fabrication and reverse osmosis units.⁴¹⁸ This support placed considerable demands on these companies and issues were soon raised in areas such as welding.⁴¹⁹ As Hall and Markowski state, Collins (and JORN) have 'achieved levels of Australian and New Zealand content averaging in excess of 70%'.⁴²⁰

⁴¹⁴ Political expediency was raised as the main driver for the decision, particularly as the announcement was made in the climate of a general election. The West Australian Premier, Dr Gallop, stated that the decision 'has got less to do with the defence of Australia and much more to do with the defence of marginal seats in South Australia', *Australian*, 26 July 2001, p. 4. For elaboration on the political debate surrounding the decisions regarding the maintenance and repair facilities see Trevor Thomas, 'Defence's political show hits on Adelaide', *Australian Defence Business Review*, 31 October 2001, p. 9.

⁴¹⁵ Prescott and McIntosh raised the 'wear and tear' issues due to the long transit times between Sydney and Fremantle. McIntosh and Prescott, *Report to the Minister for Defence on the Collins Class Submarine and Related Matters*, p. 8.

⁴¹⁶ McIntosh and Prescott, *Report to the Minister for Defence on the Collins Class Submarine and Related Matters*, p. 21.

⁴¹⁷ McIntosh and Prescott, *Report to the Minister for Defence on the Collins Class Submarine and Related Matters*, p.4

⁴¹⁸ Commonwealth of Australia, Department of Defence, *Defence Report 1988-89*, AGPS, Canberra, 1989, p. 26.

⁴¹⁹ The steel and associated welding technology was initially seen as high risk. As a result, DSTO became involved in the technology. Eventually, the success of the welding during the fabrication exceeded that of the Swedish builder. See McIntosh and Prescott, *Report to the Minister for Defence on the Collins Class Submarine and Related Matters*, p. 6.

⁴²⁰ Peter Hall and Stefan Markowski, 'Defence Industry and Local Contents Requirements', in Graeme Cheeseman, (ed.), *Fostering an Indigenous Defence Industry*, p. 53.

The Science and Technology support to be provided by DSTO was not clear at the outset of the program. DSTO had little or no direct experience in submarine technologies but the general discipline based expertise such as fluid dynamics, materials science, structures, and sonar technology did provide some basis although it is not apparent that there was any direct effort to increase these capabilities in anticipation of the program. As the program progressed, interaction between industry and DSTO increased with work on fuel cell technology, welding technology and Sterling cycle engines. McIntosh and Prescott noted that

[T]he Defence Science and Technology Organisation's role has not been sufficiently defined, despite their great deal of expertise in relevant areas; an earlier and more formal role might have been expected.⁴²¹

The Collins-class submarine program appears to support the hypothesis that DSTO is still not closely linked with industry projects. The industry and science policies do not appear to be synchronised. DSTO appears to be reactive to Defence policy decisions, while at other times leads defence capability priorities, as in the case of JORN.

Alliance versus independence

During the test and evaluation phase of the submarine acceptance trials a number of serious deficiencies were raised including the combat system, the propeller and high acoustic emission levels. Access to US Navy research and development facilities was sought and proved invaluable in a 'fast tracking' process to get the submarines in service.⁴²² The necessity to turn to the US, Australia's alliance partner and prime technology source of submarine technology, is indicative of the tenuous goal of broad self-reliance.

⁴²¹ McIntosh and Prescott, *Report to the Minister for Defence on the Collins Class Submarine and Related Matters*, p. 14.

⁴²² The 'fast track' upgrade approved in June 1999 took 12 months and cost \$266m, *Australian Defence Report*, Vol. 12, No. 3, 1 March 2001, p. 13.

US superiority in submarines and anti-submarine warfare is a closely guarded technology advantage that the US holds.⁴²³ In seeking to solve a number of problems, the Navy has gained access to classified US submarine technology. The access to this technology is a benefit of the US alliance but the various foreign ownership issues surrounding the ASC has led to strict controls by the US on the technology and its dispersion into foreign hands.⁴²⁴ The second point relates to the access to US systems that then allow for interoperability with US forces. The access to science and technology has been a major relief to the ASC.⁴²⁵ The decision in 2001 to go with a US combat system has generated much political debate and is indicative of the strong alliance pressures, including interoperability.⁴²⁶ The proponents of the unstoppable globalisation forces are quickly checked when military technology transfer and alliance obligations are called in.

The decision to acquire the Collins-class submarine, particularly with the expanded role being developed, supports the trend toward the RMA. Australia's inability to build and develop a complex system without external help reinforces the notion that involvement with RMA activities in many senses puts pressure on the goal of self-reliance. The overwhelming pressure that appeared to be applied by the US for reasons of interoperability and compatibility show the level of alliance obligations, as well as the complexity of, and limited access to, technology involved in the 'system of systems'.

External factors affecting the development of the Collins-class

The global industry trends, which include transnational mergers and increasing complexity and cost, have impacted the ASC. It can be argued that the overall requirement for interoperability and protection of intellectual property in particular combat systems and propeller design has had an overriding influence such that these have been able to overcome the supposed impact of globalisation—reduction of state power, reduced or ineffectual state borders for influence. The consolidation of shareholding and the takeover of Kockums by the German company, HDW, simply compounded the relationships between the Navy and the industrial support required to

⁴²³ Michael Brown, 'The Case Against the B-2', *International Security*, Vol. 15, No. 1, 1990, pp. 139–40.

⁴²⁴ Geoffrey Barker, 'Five to dip toes into sub builder's waters', *Australian Financial Review*, 31 October 2000, p. 8.

⁴²⁵ Fred Brenchley, 'Defending Posts', *The Bulletin*, 15 August 2000, p. 36.

⁴²⁶ The German reaction to the buy-back of its shares was muted. Threats of litigation were not forthcoming in the short-term. See *Australian*, 14–15 July 2001, p.5

build and support the submarines. From a policy of self-reliance, the global trends of transnational mergers have had less impact than may at first be thought. Not long after takeover, the Australian government, amidst concerns as to access to US technology, acquired the shares of Celsius Pacific and then Kockums.⁴²⁷ There is no evidence to suggest that the might of global capital markets was in any way reactive to the heavy handed buy-back by the Commonwealth. The actions were seen to be within the realm of national security and the maintenance of an alliance partnership. Nevertheless, the Collins combat system imbroglio that occurred in 2000 and 2001 is perhaps indicative of these influences. The initial Collins combat system was found to be one of the prime concerns in the McIntosh and Prescott report. The fixing of this deficiency was seen to be of the highest priority as the combat system essentially allows the incorporation of all sensor and intelligence data to aid the submariner in choosing targets and then control of the weapons firing.⁴²⁸ The global trend of defence transnational mergers has seen the change of ownership impact the ability of nations to exchange data.⁴²⁹ Similarly the rapid changes in communications are indicative of the rapid changes in commercial communication systems that are arguably leading those in the defence sector. The defence sector, industry and science, is perhaps for the first time being led by commercial-off-the shelf (COTS) technologies and a paradigm shift is required for them to make best use of these capabilities.

⁴²⁷ The Celsius Pacific transfer resulted from the original sale of the shares of the Australian Industry Development Corporation to the then Australian-owned Australian Defence Industries. ADI, an amalgamation of the previous government owned defence manufacturers, was sold to Celsius Pacific. In October 2000, the Commonwealth purchased Kockums 49%. The complex circular route in which the shares were returned to Australian ownership indicates the sensitivity concerning shareholdings of critical industries, *Australian Defence Magazine*, April 2001, p.10; *Australian*, 28 June 2001, p.2.

⁴²⁸ The acquisition of targets and the tracking of multiple threats is an extremely complex task. Submarines patrolling the densely travelled shipping lanes such as those in the South China sea give rise to complex issues of threat confirmation, avoidance of detection etc. For further on operational requirement differences see Terence Roach, 'Opportunity knocks for the Collins class', *Asia-Pacific Defence Reporter*, October–November 2000, pp. 38–39.

⁴²⁹ The Swedish company Kockums was taken over by the German company and this led to an additional level of complexity in the exchange of data.

In summary, a number of arguments support the claim that the broad notion of self-reliance, loosely interpreted to support the plethora of defence science activities, is flawed. While the operation and support of the submarine contributes to the goal of self-reliance, the form of the industry support is less clear. The local construction of the submarines can be argued to be a one-off activity, with a not insubstantial cost premium, that does not fundamentally enable Australia to act independently. The maintenance, repair, support and development including the replenishment of consumables such as weapons, clearly does support the notion of self-reliance from all viewpoints. The science and technology used to support the submarine did contribute to an independent posture but in a reactive way and with significant support from the alliance.

CHAPTER 6 CONCLUSION

The idea that Australian defence science and technology contributes to self-reliance may appear trite in defence policy literature. However, when the term self-reliance is examined it is quickly found that in its broadest interpretation, that is independence, it offers little utility particularly when examining the role of defence science in achieving self-reliance. In exploring the thesis, four key questions were asked.

Firstly, how is self-reliance defined in the Australian context? The literature did not produce a precise definition of self-reliance. While the term is widely used in defence literature, it is usually undefined, and therefore it can be broadly defined as independence.⁴³⁰ The term was first introduced into the Australian security context in the early 1970s but it was not until the 1986 Dibb Review that there were any substantial efforts to evaluate the definition. Dibb proposed that self-reliance was only an effective notion when the tasks that the ADF were likely to engage in are restricted to low to medium-level conflicts. As a result, he argued that Australia should limit its application to these scenarios and in the case of large-scale conflict Australia should look to the alliance, hence the mantra of limited 'self-reliance within an alliance framework'. This limited definition appears to be important because it allows some discrimination when examining the efficacy of various activities, military, industry and science and technology, against the goal of achieving self-reliance. By the 2000 White Paper the notion had become a principle of defence policy, but without any of the refinement awarded during the Hawke and Keating years.

⁴³⁰ Occasional clarification of the term is offered but only to indicate that it does not refer to self-sufficiency. For example see Woodman, 'Exploding Myths: Defence Policy for Industry Beyond the Price Review', p. 29.

Secondly, what elements comprise self-reliance? While the term is generally ill-defined, Beazley put forward an acceptable model that stated that self-reliance was based on two pillars. The first pillar relates to a clear definition of the strategic environment that leads to a force structure dictated by geopolitical circumstances. The second pillar comprises an industrial base that is both technologically advanced and competitive, and able to supply and support the forces. Australia's self-reliance therefore includes military capability, civil and defence industry and science and technology. Dibb had argued that industry is 'limited to the extent... [it] is necessary for the effectiveness and sustainability in combat of our forces'.⁴³¹ Dibb also argued that there were a range of military and industry activities that would not fulfil the notion of self-reliance.

The ability to maintain, repair, modify and adapt platforms and weapons and provide logistical support to the ADF are important. This support, when the ADF is engaged in low to medium-level conflicts, may not engage the interests or the support of the US, is far more important than, for example, the ability to design and build major platforms. The emphasis on this later capability, by both defence and defence industry, is to the detriment of the ADF engaged in combat. Two reasons were proposed. Firstly, the emphasis on building platforms was not an effective use of limited resources especially given the small numbers required and opportunities for export. Secondly, the expansion of the defence industry in the 1980s and 1990s appears to be influenced by factors external to defence such as social and economic policies to increase jobs and reduce the trade deficit. The aim of developing a sustainable industry appeared to be neglected.

⁴³¹ Dibb Review, p. 107.

The establishment of a technologically advanced defence capability is inexorably linked with a science and technology base to support a self-reliant defence posture. DSTO, and its predecessors, have provided Australia with independent scientific capability since the early days of direct industry support through to the 1960s and 1970s. During these times, the pursuit of science for pure research curiosity, alliance obligations and industry development were all seen as valid. The 1980s and the 1990s saw an increased alignment of defence science and technology and defence policy. DSTO now articulates self-reliance as a guiding principle to which it adheres, but when the limited notion of self-reliance is applied, many activities of DSTO fall into the broad category of independence. The notion of self-reliance is not sufficiently defined, nor refined, in defence policy to discriminate between various activities or provide strategic policy direction. As an example, industry has questioned whether the focus of DSTO is in supporting indigenous industry long-term or continually developing an ever-expanding range of technologies to support future high technology capability developments. In the former case, the evidence suggests a lack of perseverance by DSTO in developing technologies such as those used in Jindivik and Barra. In the latter case, a broad basket of technologies were developed to support the acquisition of both JORN and the Collins-class submarine.

Despite calls for increased DSTO and industry interaction since the Internal and External Reviews of DSTO in 1980, and further prompting in every White Paper since, there is little evidence to support a noticeable increase in Australian industry. This is despite an increase in the various numbers of industry agreements and alliances. DSTO's ever-increasing role in Defence may be part of the explanation, as much as it is not a research and development arm of an industry that appears to perform little research of its own. The lack of any significant progress in responding to the ubiquitous calls for increased industry interaction may be due to this conflict in views of the role of DSTO and industry.

Thirdly, what are the endogenous and exogenous constraints upon self-reliance? While the notion that Australia could be self-sufficient has been dismissed since the Second World War, the principle of self-reliance has also been shown to be difficult to achieve. Internal constraints include budget and societal limitations, which lead to difficulty in justifying defence force numbers and capabilities. External constraints include the Revolution in Military Affairs and global trends including globalisation and transnational mergers. The RMA and globalisation are terms that again beg for tighter definition. In the case of the RMA, the phenomenon has evolved from the initial Gulf War 'precision strike' concept through to the general concept of 'gathering, processing and acting' on intelligence. In the 2000 White Paper, the RMA is articulated as the uptake of information technology by the military. These interpretations fit into the Nye and Owens notion of a 'system of systems'. The gradual and evolutionary broadening of the range activities, implicit in the RMA, requires increased self-reliance, particularly the collection of intelligence. It is arguably just as difficult to achieve self-reliance in the 'soft' information-dominated RMA environment as it was under the hardware focused defence industry policies of the Hawke and Keating era. The RMA can be argued to increase the requirement for self-reliance, but it is again only achievable with support from the US alliance. Global trends, such as transnational mergers, have been examined and these show an increasing requirement for a self-reliant posture. Achieving this is also becoming increasingly difficult.

How effective have Australian attempts at achieving self-reliance been? Chapter 5 examined two Australian industry projects to see to what extent the projects have contributed to self-reliance. JORN was chosen as it illustrates the industry development of a DSTO concept that was instigated within DSTO, and at the time, not to any publicly articulated policy. The Collins-class submarine was chosen because it shows the development of a project with limited initial DSTO support, but one with relatively clear strategic goals.

The OTHR research carried out by DSTO, effectively since the end of the Second World War, illustrates the use of a wide variety of defence science activities to achieve JORN. Many contributing elements were not aligned with any defence policy, for example the rocket sounding research, but others were, including the Barra sonobuoy research into signal processing. The long and difficult gestation period of JORN was arguably caused by two factors. First of all, basic research almost by definition has a considerable lead-time and a high degree of uncertainty. Secondly, the lack of a strategic requirement and the initial reluctance of a Service to advocate the project contributed. The *post priori* strategic justification of the research, credible only once a working system was developed also indicates an element of serendipity. Nevertheless, JORN does fulfil both pillars of self-reliance. The industrial self-reliance element appears to be met but the inability of indigenous industry to successfully carry out the project independently is indicative of the exogenous pressures. The failure of Australia's largest telecommunications company, albeit with no prior experience in OTHR or large-scale defence projects, does not auger well if global trends for mergers continue. The ability of Australian technology to engage in RMA-era technologies, such as JORN, does offer some hope but perhaps in an interdependent way. In fulfilling the principle of self-reliance the support of Australia's alliance with major allies cannot be ignored. Overall the JORN project has illustrated the benefits of a pro-active DSTO but it also shows that leading indigenous industry capability may not in the long-term lead to a sustainable indigenous industry sector.

The building of the Collins-class submarine in Australia was in many ways the pinnacle of the Hawke and Keating government's policy of 'picking winners' in order to stimulate industry, both civil and defence. The project was aligned with strategic priorities. The decision to build the submarine in Australia broadly supported defence industry self-reliance, but the efficacy of the decision is less clear. The evidence suggests that the building of the submarine may have been justifiable industry policy and provided employment, as well as contributing to elements of defence industry self-reliance. Other alternatives without the premiums for local manufacture were arguably more supportable on declaratory defence policy alone. The science and technology support to Collins was successful but it was re-active and lacked co-ordination.

In conclusion, Australia cannot afford an alternative to self-reliance. Self-reliance while loosely defined in the Australian context is being met by both industry and science and technology. The limited definition of self-reliance proposed by Dibb appears to be more practicable even with the caveat of the alliance framework. The industry and DSTO focus on traditional high-level conflict capabilities are perhaps to the detriment of the more mundane, but nevertheless essential activities to provide a self-reliant defence posture, in the more likely scenarios of low to medium level-conflict. Two industry examples show that defence science does contribute Australia's self-reliant defence posture. The impact of the exogenous trends such as the RMA and global industry mergers appear to be still evolving and further research could be conducted into other program examples. Similarly, a more detailed analysis of the RMA in the context of Australian self-reliance is required.

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