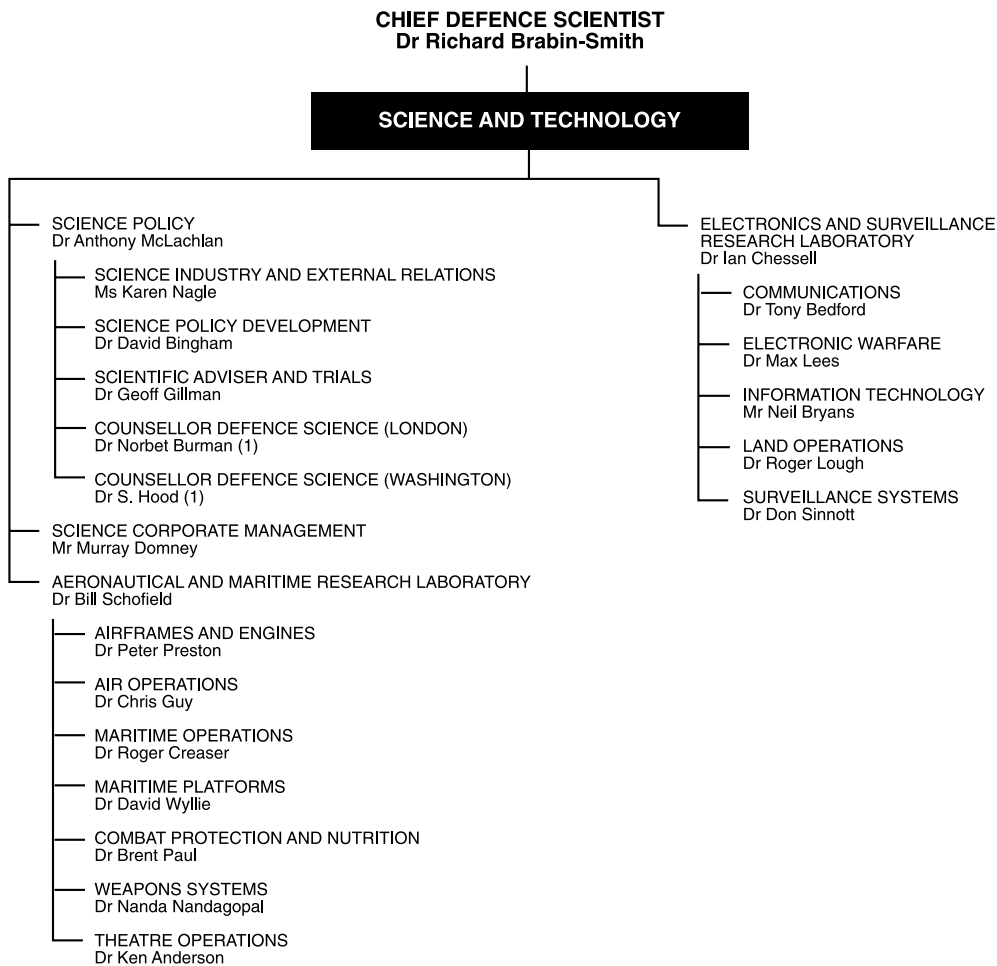


DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION



Note:

1 Responsible to the Chief Defence Scientist and to the Head of the Australian Defence Staff (Washington/London) depicted under Defence Attaches/Advisers Abroad.

Effective at 30 June 1999

GROUP 10: SCIENCE AND TECHNOLOGY

OBJECTIVE

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.

DESCRIPTION

The Science and Technology Group provides the core of Australia's skills in defence research and its applications. There are four principal supporting objectives:

- to position Australia to exploit future developments in technology which show promise for Defence application;
- to ensure that Australia is an informed acquirer of new capabilities and equipment;
- to develop new capabilities where Australia's circumstances require this; and
- to support existing capabilities by increasing operational performance and reducing the costs of ownership.

The skills required to meet these objectives enable the Science and Technology Group to support Australia's regional and global security interests and to interact with industry. The Group Manager is the Chief Defence Scientist.

PERFORMANCE OUTCOMES FOR 1998-99

This section summarises the performance outcomes for 1998-99, with more detailed information being provided in the subsequent section on performance against forecasts. This summary is necessarily selective, as the fields covered by the Science and Technology Group's support to Defence are diverse, many research programs take place over several years and many activities are classified. The Group's performance outcomes are measured by:

The extent to which clients' needs and priorities are met, and in particular:

- *advice provided to the Defence organisation to make informed decisions on new defence capabilities is timely and useful;*
- *enhancements to existing defence capabilities provide increased operational effectiveness, including more cost-effective use of personnel and materiel; and*
- *the life-of-type of defence platforms is extended, with consequent cost and operational benefits.*

The Science and Technology Group provided scientific advice to assist Defence with decisions in many capability areas. Examples include advice on airborne early warning and control aircraft, the F/A-18 Hornet upgrade, the FFG upgrade, air-to-surface stand-off weapons, electronic warfare self protection for aircraft, the Anzac warfighting improvement program, modelling and simulation, and command support systems. Substantial contributions were made towards through-life support, increased operational effectiveness, and the evolution of various existing ADF platforms and systems including the Anzac class, Collins class, the F-111, C³I systems, information networks, and surveillance systems. The Science and Technology Group contributed to the life extension of various air and maritime platforms and components that will result in substantial cost and operational benefits to the ADF. Examples include advice on extending the life of the F/A-18 aircraft structure, F/A-18 aileron hinges through bonded reinforcement repairs, turbine disks in the C-130 aircraft T56 engines, the F-111 aircraft crew module rocket motor, the F-111 airframe structure and the PC-9/A aircraft.

The extent to which those emerging technologies relevant to Australia's future needs are identified and exploited

The Group exploited a wide range of technologies with potential to enhance Defence capabilities. Some examples are:

- biosensor technology to improve detection of biological agents;
- development of smart structures to support life extension of aircraft;
- a novel 'stochastic resonance' sensor technology for future sonar systems to enhance detection of submarines;
- adapting biological electric field sensors as found in some marine life-forms to improve detection of sea mines; and
- development of high frequency surface wave radar to improve surveillance capabilities.

The extent to which Science and Technology's interactions with industry lead to an increased ability on industry's part to support Australia's national defence effort and to contribute to national wealth creation

Initiatives taken during the year include:

- producing *DSTO: Research Priorities for Australia's Defence* which gives industry a thematic overview of the Group's future directions and priorities;
- developing an industry communication strategy for implementation in 1999–2000 with the aim of providing appropriate, timely information on Defence research and development needs;
- informing a wide range of industry consultative forums and associations on topics of interest to the Science and Technology Group and Defence; and
- issuing a new Science and Technology Group industry interaction policy framework more closely aligned with the new Defence and industry policy and evolving industry capability.

The Science and Technology Group continues to engage with industry through various collaborative and commercial arrangements which include technology and information transfer. Examples of these are provided in the *Performance against Forecast* section for this Group.

The extent to which the Science and Technology Group's interactions with regional countries contribute to Australia's regional security

The Group's interactions with regional countries have continued at modest levels. The focus has been on helping regional countries sustain and increase their abilities to defend themselves in cost-effective ways and on defence issues of mutual interest. Examples of these are provided in the *Performance against Forecast* section for this Group.

The extent to which the Science and Technology Group's international interactions contribute to alliance relationships and allow access by the Defence organisation to current and future defence science and technology relevant to Australia's priorities

The Group has a strong program of international collaboration, mainly with the United States, the United Kingdom, Canada and New Zealand, but also with France and Sweden. This has contributed significantly to Science and Technology's ability to support Defence outputs across a wide range of technologies and their application, such as navigation warfare, management of surveillance assets and over-the-horizon radar.

The extent to which the overall management of, and support to, the Science and Technology Group continues to improve

The Group continued during the year to improve management and leadership training, reviewing the Graduate Program in Scientific Leadership and initiating a pilot Executive Leadership

Development Program. Progress was also made towards the new Defence science career structure that will remove artificial barriers to employees' productivity. Consolidation of the Group's facilities will also enhance its efficiency and effectiveness. The Group worked closely with the Defence service-provider Groups to improve support services to its research activities.

PERFORMANCE AGAINST FORECAST FOR 1998-99

Policy and Command

- *Operational Command:*
 - *Providing scientific advice to assist Defence in the acquisition of a military payload on board the Optus C1/D spacecraft*

Achieved as Forecast Advice was provided to the Defence project team on the functional and performance specifications for the Defence communications payload on board the spacecraft the Defence ground control segment, and the Defence ground segment. This advice enabled the project team to specify the Defence payload, to assess options and to assess tenders. Advice was also provided on vulnerability of the spacecraft command link.

- *Establishing an experimental distributed command, control, communication and information environment. This will be used to demonstrate candidate solutions to interoperability of the distributed command, control, communications and intelligence systems including the US Global Command and Control System. Network management infrastructures will also be provided.*

Achieved as Forecast An experimental distributed command, control, communication and information environment has been established with nodes in Canberra, Salisbury, and the Australian Theatre Joint Intelligence Centre/Headquarters Australian Theatre in Sydney. Network management for the environment has been installed. Limited interoperability between the United States global command and control system and the ADF joint command support system was demonstrated during the joint warrior interoperability demonstration.

- *Establishing a group in Headquarters Australian Theatre to assist in researching, defining, developing and evaluating command and control support systems for theatre-level operations*

Achieved as Forecast Command and Control Australian Theatre Group has been established and is now an integrated component of Headquarters Australian Theatre.

- *Completing a command and control study that will identify capability shortfalls and policy trade-offs to aid high-level decision making on future command and control capability development*

Achieved as Forecast The findings of the Command and Control Support Study were presented to the Defence Information Environment Board. An architectural approach to the Defence information environment was proposed.

- *Demonstrating the application of the Australian Membrane and Biotechnical Research Institute ion channel sensor technology for Defence purposes by the fabrication of a biosensor for the detection of ricin*

Achieved as Forecast The production of antibodies for use as recognition elements in the sensor is the key to this program. Purified ricin antibodies have been produced and their selectivity determined.

Maritime Capabilities

- *Capability for Major Surface Combatant Operations*
- *Improving the survivability of surface combatants against radar homing anti-ship missiles through further development of the Nulka system*

Achieved as Forecast This is a continuing bilateral product improvement activity with the United States. Science and Technology Group staff contributed in a number of joint United States/Australia technical conferences and worked with the Nulka project office to optimise the production specifications for the payload. Technical advice was also given on electromagnetic compatibility modifications.

- *Enhancing the survivability of naval platforms through the development of a suite of software tools for damage assessment, damage control, operational planning and training for surface vessels and submarines. A key deliverable in the reporting period will be a damage-control command decision aid for use on board FFG-7 frigates*

Achieved as Forecast The 'Focus' condition monitoring and damage control program has been demonstrated to industry. Negotiations are under way to finalise a licence agreement that will allow industry to produce this decision aid for use in the FFGs. The equivalent submarine program, 'Merlin', has been installed on HMAS *Farncomb* for evaluation by Navy.

- *Capability for Submarine Operations*
- *Investigating the acoustic signature of Collins class submarines to develop means to manage the acoustic signature and so increase the operational capability of the submarines*

Achieved as Forecast Investigations have resulted in a number of recommendations for the modification of the submarine to reduce machinery and flow noise. These are presently being trialed on HMAS *Collins*. The Science and Technology Group has been actively engaged in all aspects of the acoustic signature work that is directed to producing a submarine that meets the interim minimum operational capability.

- *Providing the Navy, the Science and Technology Group and industry with a laboratory environment for the rapid prototyping and evaluation of combat system concepts for the Collins class submarine, surface combatants and possibly airborne platforms. This will provide a significant contribution to the evolution of the naval combat system*

Achieved as Forecast A 'virtual submarine' has been developed in the laboratory environment and a capability to allow rapid prototyping of submarine combat system human-computer interfaces has been demonstrated. Significant progress has also been made in establishing a 'virtual ship' and a 'virtual minehunter coastal'. These will support the development and demonstration of combat systems concepts for surface combatants and the development and demonstration of operator and command decision aids.

- *Capability for Major Surface Combatant Operations and Capability for Submarine Operations*
- *Providing advice and technical assistance on the integration of weapon systems into the Anzac class ships and Collins class submarines, including collaboration with Australian industry to maintain a capability to support weapons systems/maritime platform combinations unique to Australia*

Achieved as Forecast Technical advice on submarine/Harpoon missile integration, acquisition of the Penguin missile and the Penguin tactical engagement simulator was provided to the Navy. A joint project plan with industry was established in the area of ship point defence and evolved Sea Sparrow missile integration. The Penguin missile simulator specification was reviewed. Advice on the development of insensitive munitions was provided to Australian industry.

- *Capability for Mine Countermeasures and Defensive Mining*
- *Providing advice and technical assistance to ensure that appropriate quantitative data is obtained from the shock testing of the Minehunter Coastal, including development of ultrasonic inspection methods for the composites hull. This will assist in assessing the vulnerability of the vessel to underwater blasts*

Substantially Achieved as Forecast The Science and Technology Group's advice and assistance contributed to the successful conduct of the shock trial. Post-trial reports relating to structural integrity, shock response, and quantifying the shock environment were presented after each event. Resultant maps of the locations of shock damage and characterisation of the type of damage will contribute to through-life management of the minehunter coastal structure. It was unnecessary to develop an ultrasonic inspection method as a suitable commercial system was found.

Land Force Capabilities

- *Capability for Land Task Forces Operations*
- *Developing the initial capability and technology demonstrator to demonstrate the utility of a broad-area aerial surveillance capability in support of land operations in the Restructuring the Army trials*

Achieved as Forecast The broad-area aerial surveillance capability was successfully demonstrated during the *Restructuring the Army* trials in Exercise Phoenix. The demonstrator has thus been trialed in a low intensity conflict scenario. Its utility for testing operational concepts for littoral operations has also been trialed.

- *Conducting analysis of the Restructuring the Army Task Force structures and operations to assess the effectiveness of the Task Force in conducting operations in the Top End*

Achieved as Forecast The *Restructuring the Army* task force structure and concepts for operations were evaluated using scientific processes that were rigorous and auditable. An assessment of structures and operations was provided to Army Headquarters for consideration.

- *Developing a 'synthetic environment' for linking simulations for the assessment of capability options. To demonstrate this concept, the 'environment' will be used to evaluate some specific cases of high priority to the Land Force*

Achieved as Forecast A synthetic environment was built for Exercise Phoenix that included links to a real operational command and control system, a prototype situation awareness system, and a pair of 'virtual armed reconnaissance helicopters' operated by real crews. The environment was integrated into the real exercise and allowed the headquarters to exercise the command, control, communication and information aspects of tasking the helicopters. The environment provided an opportunity to evaluate the helicopters in such an exercise without the availability of the real asset.

Part Two

- *Producing and evaluating demonstrations of improved aggregation and presentation of information on the battle situation on the computer screens of Land Force commanders (Situation Awareness) to enable better decision making*

Achieved as Forecast New concepts were produced and demonstrated to Army aviation staff in a scenario based on the tasking and mission monitoring of an armed reconnaissance helicopter. Significant reductions in the times required by commanders to plan and conduct helicopter missions were evident.

- *Providing advice to the Army on the performance of night-vision goggles. This will lead to greater safety and awareness of the limitations imposed by the goggles in aviation operations*

Achieved as Forecast Studies on visual acuity performance using night vision goggles and the light absorbing and reflecting properties of aircraft and terrain were conducted for the Army. In addition, a study was conducted which will provide Army with information about the advantages and disadvantages of incorporating flight and navigation symbols in night vision goggles.

Air Force Capabilities

- *Capability for Air Strike/Reconnaissance*
 - *Conducting simulated fatigue loading of a full-scale F-111 wing and carry-through box, followed by a teardown inspection to identify potential failure locations and crack growth rates at these locations. This will help ensure safe operation of the F-111 fleet to its planned withdrawal date of 2020*

Not Achieved as Forecast Completion of manufacture of the fatigue loading rig was delayed for three months until September 1999 due to the need to rework defective components and to delays in the manufacture of some hardware items. Fatigue testing is scheduled to commence in October 1999. This program spans several years.

- *Improving self-protection for the F-111 in reconnaissance and strategic roles through support to the RAAF for full-scale engineering development of the ALR 2002 radar warning receiver and its integration into the F-111's new electronic warfare self-protection suite*

Achieved as Forecast Technical advice was provided on full-scale engineering development, which is proceeding on schedule. The project was extended to include full scale engineering development of variants of the radar warning receiver including helicopter and C-130 versions. Initial testing of all three variants commenced.

- *Capability for Air Strike/Reconnaissance and Capability for Tactical Fighter Operations:*
 - *Improving aircraft electronic warfare self-protection capabilities through a joint research, development and engineering program with the United States by exchange of data, joint demonstration of aircraft electronic warfare using cockpit simulators, and commencement of a number of joint research and development technology programs*

Achieved as Forecast This is a continuing program which formally commenced in 1998–99. Major achievements since commencement include agreement with the United States on a detailed research, development and engineering program; commencement of activities in 10 technology areas which will contribute to enhancements to each nations' aircraft electronic warfare self-protection capabilities; and a successful demonstration of new situational awareness concepts.

- *Capability for Tactical Fighter Operations*
- *Developing models of pilots' tactical reasoning using artificial intelligence technology to contribute to more reliable evaluations of Australia's air defence system*

Achieved as Forecast Models have been developed with a focus on standard tactics. Development is continuing on a wider range of tactical options than is currently available to pilots.

- *Capability for Strategic Surveillance*
- *Contributing to the evaluation of responses to the Airborne Early Warning and Control aircraft tender by providing advice on scientific issues*

Achieved as Forecast Evaluation advice was provided in 19 subject areas. This involved over 70 subject-matter experts, spanning seven science and technology divisions, and formed the scientific and technological basis for the source evaluation. Contributions were also made to the development of the evaluation methodology.

- *All Defence Outputs Involving Aircraft*
- *Developing a sensor that has the capability to detect and measure rates of corrosion, thereby reducing the costly (in terms of dollars and aircraft availability) unscheduled maintenance that results from corrosion*

Achieved as Forecast A prototype sensor has been developed which uses electrochemistry as the basis for detecting and measuring corrosion. Through a licensing arrangement, the device is being miniaturised and developed for commercial application in the aircraft industry.

- *Completing the fatigue testing on PC-9/A and providing Support Command Australia with advice for extending the structural airworthiness clearance of PC-9/A from 6,000 hours to 10,000 hours, and information on airframe modifications, fleet usage management and life extension options*

Substantially Achieved as Forecast Subject to the results of a residual strength test and 'teardown' inspection, the fatigue test has shown that the PC-9/A aircraft can be operated to 10,000 service hours. The fatigue test results will have a significant impact on fleet cost reduction and fleet maintenance management.

Defence Science and Technology Research

- *Developing new methods, based on thermal excitation and emission, for identifying defects and stress fields in structural components to reduce cost of ownership of ADF aircraft*

Achieved as Forecast Methodologies have been developed to assist in the quantitative interpretation of thermographic data in the context of metallic corrosion and composite delamination problems in aircraft. A new high-speed thermographic inspection system is to be developed that will provide the requisite practical capability required to capitalise on these achievements.

- *Investigating the sonar reflectivity of the inhomogeneous sea bed and refractive properties of the sea, so that the maritime environment may be better used to the advantage of the ADF*

Achieved as Forecast This is a long-term research activity. The goal is to derive geoacoustic models for the seabed at various Australian sites of interest to the Navy for use in tactical

Part Two

decision aids. Substantial progress has been made with the two permanent Navy sound ranges at Jervis Bay in the Australian Capital Territory and Thistle Island in South Australia.

- *Research to improve the capability to develop guidance software for air defence, point defence and other missile systems*

Achieved as Forecast A basis for algorithms has been established that will considerably improve the ability of air and point defence systems to defeat highly manoeuvrable targets has been established.

Industry and External Relations

- *Activities which will be pursued during 1998-99 include placing research and development contracts and licence arrangements with industry, universities and other research organisations; developing existing and new industry alliances and other collaborative arrangements in a variety of areas; and developing beneficial affiliations with other research institutions*

Achieved as Forecast During the period, the Group sourced research and development and technical support to the value of \$23.04m from industry and other external agencies. It signed an additional six research agreements, 13 collaborative agreements, nine licences, and one alliance.

As at 30 June 1999, the Group's portfolio of agreements comprised 12 research agreements, 26 collaborative agreements, 64 licences, 18 industry alliances and five memoranda of understanding. The Group also participated in nine cooperative research centres.

International and Regional Cooperation

- *Extensive interaction and cooperation with the United States, the United Kingdom, Canada and New Zealand will continue under the auspices of The Technical Cooperation Program and bilateral agreements. Long-standing defence research and development arrangements with Sweden and France will continue*

Achieved as Forecast The Science and Technology Group continued its strong program of international collaboration, mainly with the United States, the United Kingdom, Canada and New Zealand, but also with France and Sweden. In 1998-99, four new project arrangements to the Deutch-Ayers Agreement with the United States were signed. These allowed Defence access to information on such technologies as navigation warfare, management of surveillance assets and over-the-horizon radar. The Group also entered into a collaborative program with the United Kingdom for longer-term support of the ASRAAM missile.

- *The Science and Technology Group will also continue to provide technical support to Australia's United Nations and global security activities*

Achieved as Forecast Expert advice continued to be provided in support of international arms control with the emphasis shifting from the chemical protocol to cover both chemical and biological protocols. Regional interactions have continued with efforts in Indonesia culminating in that country's ratification of the Chemical Weapons Convention. Staff participated in three United Nations Special Commission missions in Iraq.

- *Revising the Memorandum of Understanding on Defence Science and Technology with Canada*

Achieved as Forecast Collaboration with Canada is now covered by a contemporary memorandum of understanding, which was signed in late 1998.

- *Increasing collaboration with France and Sweden*

Achieved as Forecast Significant progress was made in identifying collaborative opportunities with France and two technical arrangements were signed; one covering a trial of an infrared search and track system and the other in the area of composite materials for aircraft. Visits between Sweden and Australia revealed several areas for collaboration; these include blast effects of land mines and bonded composite aircraft repairs.

- *Cooperation in our region in defence science and technology will continue through a range of collaborative activities conducted under existing bilateral defence, and science and technology, cooperation arrangements with Indonesia, Malaysia, Singapore and Thailand*

Achieved as Forecast Regular personal contact and ongoing discussions have been maintained with key personnel in all four countries. Despite the current South East Asian financial difficulties, a number of activities have taken place. Among them were discussions with Malaysia and Thailand which addressed the repair and management of aircraft; Indonesia, Thailand and Malaysia on monitoring the ionosphere to optimise global positioning system and high frequency communications; and Thailand on monitoring ambient sea noise. An agreement to undertake a new joint project with Singapore on ship-shock modelling has been finalised.

Corporate Planning and Support

- *Implementing a new classification structure for Science and Technology Group staff working in research and development which will remove unnecessary barriers to career advancement and allow a more flexible approach to working arrangements that will enhance the Group's ability to achieve its outcomes*

Partially achieved as Forecast The new unified industrial structure for the Science and Technology Group, the Defence Science Career Structure, has been designed and is planned for introduction as part of the next Defence agency agreement during 1999–2000.

- *Finalising approval of the property rationalisation in Melbourne; progressing planning and approvals for the relocation of elements of Maritime Operations Division from Pyrmont, Sydney; and obtaining approval for facilities needed to accommodate additional staff and equipment resulting from the increase in the Science and Technology Group's Five Year Defence Program allocation*

Substantially Achieved as Forecast The rationalisation of the Science and Technology Group's facilities in Melbourne was announced in the 1999–2000 Budget. Planning is continuing for other enhancements and rationalisation in Sydney and at Salisbury in South Australia.

- *Initiating an executive leadership development program to enhance the leadership and management skills of senior research and development staff*

Achieved as Forecast The executive leadership development pilot has been successfully initiated and consideration is being given to the ongoing program of executive leadership development in the Group.

RESOURCES

Table 10.1: Defence Function Outlays Summary

Sub-Group	1998-99	1998-99	1998-99	Variation	
	Budget Estimate	Revised Estimate	Actual Outcome	(98-99 Actual less Revised Estimate)	
	\$m	\$m	\$m	\$m	%
10.1 Aeronautical & Maritime Research	93.2	98.3	101.1	2.8	2.8
10.2 Electronics & Surveillance Research	75.7	77.0	77.4	0.3	0.4
10.3 Executive & Support	38.6	41.9	42.8	0.9	2.1
Group Total	207.5	217.3	221.3	4.0	1.8

Table 10.2: Staffing Summary

Sub-Group	1998-99	1998-99	1998-99	Variation	
	Budget Estimate	Revised Estimate	Actual Outcome	(98-99 Actual less Revised Estimate)	
	Personnel	Numbers		No	%
10.1 Aeronautical & Maritime Research	1,045	1,000	981	-19	-1.9
10.2 Electronics & Surveillance Research	779	768	745	-23	-3.0
10.3 Executive & Support	382	375	364	-11	-2.9
Group Total	2,206	2,143	2,090	-53	-2.5

Table 10.3: Staffing Profile

Personnel		Sub-Group			
		10.1	10.2	10.3	Total
Permanent Force	98-99 Budget	8	0	15	23
	98-99 Revised	8	0	15	23
	98-99 Actual	8	0	15	23
Civilian	98-99 Budget	1,037	779	367	2,183
	98-99 Revised	992	768	360	2,120
	98-99 Actual	973	745	349	2,067
Total	98-99 Budget	1,045	779	382	2,206
Personnel	98-99 Revised	1,000	768	375	2,143
	98-99 Actual	981	745	364	2,090

1998-99 Defence Reform Program Progress

In 1998-99, Science and Technology achieved its Defence Reform Program gains through general administrative efficiencies.

In 1998-99, the funding baseline was increased by \$15m. Consistent with the priorities of Australia's Strategic Policy, this additional funding was used to undertake research in the areas of:

- the knowledge edge (support to Headquarters Australian Theatre, information operations, ADF participation in regional coalition operations, surveillance, establishment of the Theatre Operations Branch, formation of Command and Control Australian Theatre Group and its collocation with Headquarters Australian Theatre);
- defeating threats in our maritime approaches (improvements to weapons systems effectiveness, performance of non cooperative target recognition, reducing the vulnerability of naval platforms to infra-red guided threat missiles, developing an

- integrated hard and soft kill defensive system, support to the Collins-class submarines);
- strike (advanced radio frequency countermeasures, beyond visual range modelling, weapons and stores clearance); and
- defeating hostile land forces (developing Land Operations Division, detection and analysis of biological agents, logistics support of land operations).

Table 10.4: 1998-99 Defence Reform Program Resources Available for Reinvestment

Category	1998-99	1998-99	1998-99	Variation	
	Budget Estimate	Revised Estimate	Actual Outcome	(98-99 Actual less Revised Estimate)	
	\$m	\$m	\$m	\$m	%
Administrative Support	0.4	0.4	0.4	0	0
Total	0.4	0.4	0.4	0	0

Table 10.5: 1998-99 Defence Reform Program Personnel Reductions – APS

Sub-Group	1998-99	1998-99	1998-99	Variation	
	Budget Estimate	Revised Estimate	Actual Outcome	(98-99 Actual less Revised Estimate)	
	Personnel Numbers			No	%
Science and Technology	99	0	0	0	0
Total Personnel Reductions	99	0	0	0	0

Note: The 99 civilian personnel reductions were recorded in the *Portfolio Budget Statements 1998-99* against the Science and Technology function relating to support personnel. These personnel savings have been transferred to Defence Corporate Support (89) and to Defence Estate(10).

Table 10.6: 1998-99 Defence Reform Program Reinvestment

Sub-Group	1998-99	1998-99	1998-99	Variation	
	Budget Estimate	Revised Estimate	Actual Outcome	(98-99 Actual less Revised Estimate)	
	\$m	\$m	\$m	\$m	%
Science and Technology	15.0	15.0	15.0	0	0
Total	15.0	15.0	15.0	0	0

Table 10.7: Reconciliation of Appropriations for the Science and Technology Group

Division/Appropriation Item	1998-99	1998-99	1998-99	Variation	
	Budget Estimate	Revised Estimate	Actual Outcome	(98-99 Actual less Revised Estimate)	
	\$m	\$m	\$m	\$m	%
180-01 Running Costs					
Service Personnel	1.6	1.6	1.7	0	1.6
Civilian Personnel	133.7	138.8	143.2	4.4	3.2
Administrative Expenses	41.0	46.6	46.3	-0.4	-0.8
180-02 Other Services	0.6	0.6	0.6	0	0
181 Equipment & Stores	32.8	31.9	32.7	0.9	2.7
Total Defence Function Appropriations (A)	209.8	219.6	224.5	4.9	2.2
Total Defence Function Receipts (Offset within Outlays) (B)	-2.3	-2.3	-3.2	-0.9	40.1
Total Defence Function Outlays (A+B)	207.5	217.3	221.3	4.0	1.8

Full accrual information for this Group is available in the *1998-1999 Financial Statements* in Appendix F to Part One of this document.

Table 10.8: Major Variations between 1998-99 Revised Estimate and 1998-99 Actual Outcome

Appropriation	\$m
180-01 RUNNING COSTS	
Civilian Personnel (\$4.4m)	
Increase for permanent staff due to higher than anticipated per capita rates of staff recruited during the year.	2.9
Increase for civilian redundancies associated with the restructure of Maritime Operations Division.	0.7
Increase for management initiated civilian redundancies.	0.6
Variation in accrual based superannuation payments and 3 % productivity benefit liability based on movement in average staffing levels, changes in per capita rates and the impact of pay increases	0.5
Miscellaneous minor variations	-0.3
Administrative Expenses (-\$0.4m)	
Increase in capability initiatives associated with aeronautical and maritime research.	0.7
Increase in capability initiatives associated with electronic and surveillance research.	0.7
Miscellaneous minor variations	0.2
Reduction in staff employed under technical support contracts	-2.0
181-00 EQUIPMENT AND STORES (\$0.9m)	
Net Group transfers primarily associated with Project Air 5417 (for the purchase of missile flight simulators) from Group 1.	1.9
Reduction in equipment & stores due to changing priorities in research tasks.	-1.2
Miscellaneous minor variations	0.2
DEFENCE PORTFOLIO RECEIPTS (-\$0.9m)	
Increased receipts due to additional sales of surplus stores.	-0.2
Increased commercial receipts due to higher than anticipated activity.	-0.5
Miscellaneous minor variations.	-0.2

