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DEFENCE TEST AND EVALUATION ROADMAP 2008

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FOREWORD

Test and Evaluation (T&E) is one of the key enabling activities that underpin the ADF's capability development process to realise CDF's vision for a balanced, networked and deployable force. Defence's T&E approach will ensure that the capabilities that are fielded are tested and evaluated and are suitable for ADF operations.

Defence's T&E approach contributes to the development of systems and capabilities, and articulates a strategy for managing T&E resources to meet the needs of the Defence Capability Plan (DCP).

The T&E Roadmap achieves this by outlining the:

- factors that influence the T&E to enable delivery of capability;
- a framework for understanding the T&E requirements in the future joint operating environment;
- requirement for T&E to be conducted at all stages of a capability's life cycle;
- Defence's current T&E capabilities; and
- how Defence's future T&E requirements are to be realised.

T&E can be employed to prove, demonstrate or assess the ability of proposed and existing capability systems, new or upgraded, to satisfy specified technical and operational requirements and objectives. When T&E is employed in this manner, with the objective of providing results to inform decisions at key milestones in a capability system's life cycle, it becomes an effective component of a capability risk management strategy.

The results of T&E will be used to provide proof that risk is contained within acceptable boundaries when making key life cycle milestone decisions and that the intended system meets both safety standards and end-users' requirements.

This Roadmap identifies Defence's key actions for T&E as:

- development of a centralised and coordinated approach to Defence's T&E resources and priorities;
- a proposed T&E framework that considers T&E at the system, platform, environment and joint capability levels;
- establishment of appropriate and sufficient resourcing levels for T&E in the development of capability; and
- planning and accounting for an increasing number of projects that have high technology combination of complex subsystems.

Defence understands that key partnerships need to be established in order to gain the maximum leverage to assist with the development of its T&E capability. Defence's key partners include:

- Industry;
- other Government agencies; and
- our allies and multi-national partners.

Pivotal to the development of these relationships is the requirement to clearly articulate Defence's T&E approach and strategies to ensure the delivery of appropriate and relevant T&E to Defence.

The T&E Roadmap will be revised to remain synchronised with Defence's strategic direction, T&E policy, capability development processes and changes to the DCP.

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CONTENT

PART 1

THE PURPOSE OF DEFENCE T&E

T&E is a process to obtain information to support the objective assessment of a Capability System with known confidence, and to confirm whether or not a risk is contained within acceptable boundaries across all facets of a system's life cycle.

CHAPTER 1 - INTRODUCTION

PURPOSE

The CDF has stated that his vision for the ADF is a '*balanced, networked, and deployable force, staffed by dedicated and professional people, that operates within a culture of adaptability and excels at joint, interagency, and coalition operations.*'[1] The aim of the Defence Test and Evaluation (T&E) Roadmap is to review the current Defence T&E capability, Defence's strategic planning for future operating environments, and the future capability acquisition plan as detailed in the DCP 2006–2016, to ensure Defence's T&E direction and resources will be adequate to assist in the delivery of the CDF's vision.

This document explains the benefits of T&E to Defence and how it can assist the capability development process. It considers Defence's current T&E capability and policy, the level at which T&E is being performed, when it is undertaken, and what T&E resources are utilised. Importantly, the Roadmap considers the extent of the gaps and overlaps in the delivery of T&E which may impact on the delivery of DCP projects, and the resources that will be required to deliver these projects into service.

[1] *Joint Operations for the 21st Century, page 3*

This Roadmap's broad aims include:

- reviewing the benefits of T&E in the capability development process;
- providing an overview of resourcing Defence's T&E capability to achieve successful project outcomes as outlined in the DCP;
- informing both industry and the Defence community of the ADF's T&E strategy; and
- provide future T&E direction regarding identified shortfalls.

To address these objectives, the Roadmap is divided into three parts covering:

- the purpose of Defence T&E;
- the existing Defence T&E environment – current T&E capabilities including agencies and facilities, with extant T&E policy, principles and guidance; and
- the future – the transformation of the T&E environment to enable more rapid fielding of capabilities to meet the Future Joint Operating Concept (FJOC).

T&E DEFINED

T&E can be defined as a process that obtains information to assist in the evaluation or support the objective assessment of a capability system with known confidence, and to confirm whether or not a risk is contained within acceptable boundaries across all phases of a system's life cycle.

PURPOSE OF T&E

The fundamental purpose of T&E in a Defence system's development and acquisition program is to identify the areas of risk to be reduced or eliminated. During the early phases of development, T&E is conducted to demonstrate the feasibility of conceptual approaches, evaluate design risk, identify design alternatives, compare and analyse trade-offs, and establish satisfaction of operational requirements.

As a system undergoes design and development, the iterative process of testing moves gradually from a concentration on Development Test and Evaluation (DT&E), which is concerned chiefly with attainment of engineering design goals, through Acceptance Test and Evaluation (AT&E) to increasingly comprehensive Operational Test and Evaluation (OT&E), which focuses on questions of operational effectiveness, suitability and survivability.

Although there are usually separate Development Test (DT) and Acceptance Test (AT) events, DT&E and AT&E are not necessarily serial phases in the evolution of system development. When appropriate, combined or concurrent DT and AT or Operational Tests (OT) are encouraged. This concurrency of testing can contribute to savings in costs and time in many circumstances.

Significant risk identification and mitigation is possible when activities such as OT&E are conducted early in a capability system's life cycle.

CHAPTER 2 - T&E IN THE CAPABILITY LIFE CYCLE

CAPABILITY SYSTEM LIFE CYCLE

Each capability system has a 'life cycle' that begins with the identification of the need to address a current or prospective capability gap. This need is progressively translated into a working capability system that is operated and supported within one of the combat operating environments until it is ultimately withdrawn from service. The stages of capability life cycle are:

- Needs,
- Requirements,
- Acquisition,
- In-Service, and
- Disposal.

There are a number of inputs which must be considered when developing future capabilities (or capability systems) within each of the combat environments – Maritime, Land, and Aerospace (or Air and Space), and also within capability enablers such as Network Centric Warfare (NCW). These have been defined in the Defence Capability Development Manual 2006 (DCDM) as Fundamental Inputs to Capability (FIC). These inputs are:

- Personnel,
- Organisation,
- Collective Training,
- Major Systems,
- Supplies,
- Facilities,
- Support, and
- Command and Management.

T&E applies equally to all of the above areas, not just Major Systems. T&E activities are applicable **throughout** the system's life cycle and are not confined to system acceptance or transition to in-service. Significant benefits will be obtained through the application of T&E activities early in the capability system's life cycle. The primary benefit is the reduction in development costs through the early identification of risks and capability shortfalls.

Figure 1 details the broad T&E undertaken in the life cycle of capabilities.

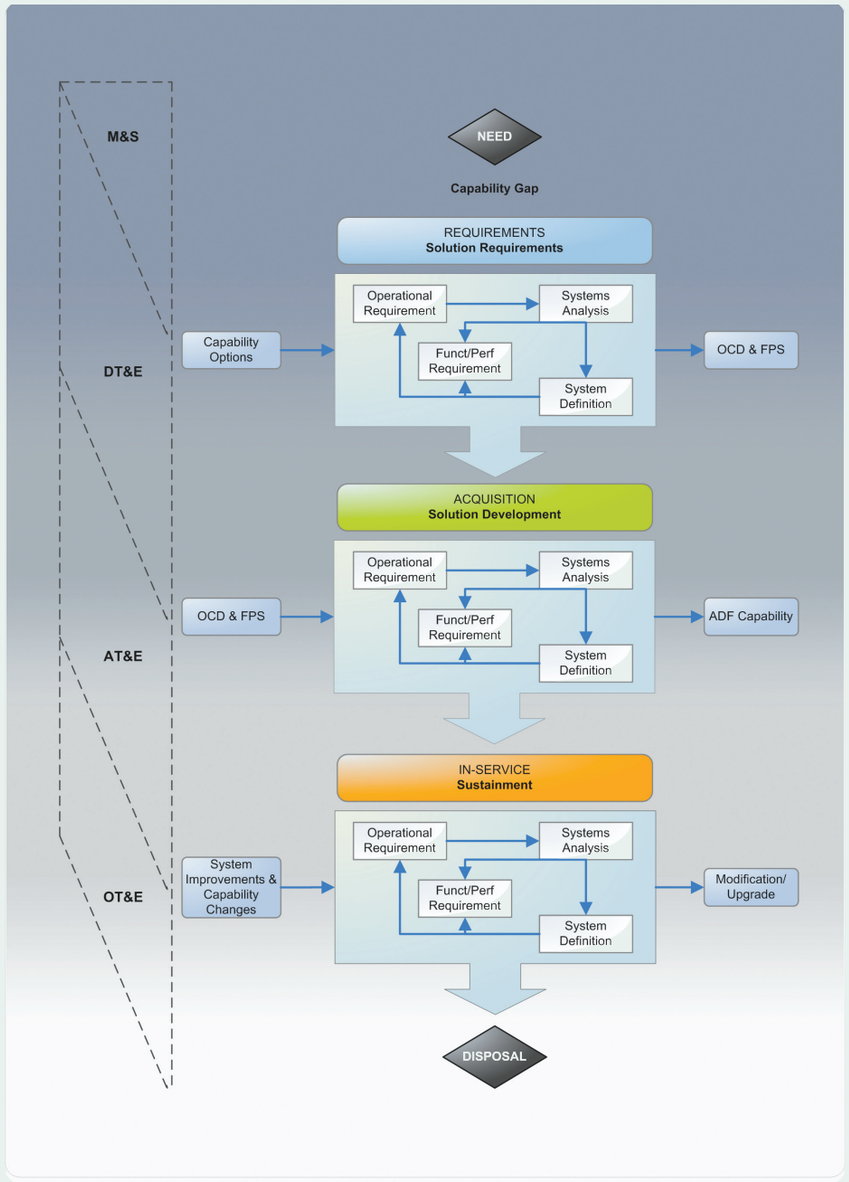

Figure 1: Capability Life Cycle

T&E'S CONTRIBUTION TO CAPABILITY

T&E contributes to ensuring that Defence's future capability needs are met and value for money is achieved.

The level of T&E effort applied in support of the development of capability should be proportional to the level of risk identified at each life cycle stage and in relation to the importance of the capability to Australia's defence needs.

Additionally, T&E should be structured to provide essential information to decision makers, assess attainment of technical performance parameters, and determine whether systems are operationally effective, suitable, sustainable, safe and environmentally compliant for intended use.

The results of experimentation of future concepts via Modelling and Simulation (M&S) can be used by T&E where appropriate in the Needs phase. A range of DT&E and AT&E activities will be conducted during the Requirements and Acquisition phases. OT&E for both Major and Minor projects mostly occurs throughout the In-Service phase, although significant benefits can be obtained through early validation of a capability through measured user input via early OT&E activities.

The conduct of T&E should facilitate learning, assess technology maturity and interoperability, facilitate integration into fielded capabilities, and confirm performance against documented capability needs.

T&E AND THE SYSTEMS ENGINEERING PROCESS

The Systems Engineering Process (SEP) is the integrated set of interdisciplinary tasks that are required throughout a systems's life cycle, to transform customer needs, requirements, and constraints into a system solution. The SEP focusses on the total technical effort of engineering activities necessary to guide product development whilst ensuring that the product is properly designed to make it affordable to produce, own, operate, maintain, and eventually to dispose of, without undue risk to health or the environment. Furthermore, the SEP includes the life cycle processes for manufacturing, test, distribution, support, training, and disposal, which are necessary to provide life cycle support for products.

The T&E process is an integral part of the SEP, which identifies levels of performance and assists the developer in correcting deficiencies. It is a significant element in the decision-making process, providing data to support trade-off analysis, risk reduction, and requirements refinement. Program decisions on system performance, maturity and readiness to advance to the next phase of development are based on the results of T&E. The issue of paramount importance to the user is system performance; that is, can the system fulfil the mission? This question applies to all elements of FIC, not just Major systems. The T&E process provides data that informs the user on how well the system is performing during development and if it is ready for fielding.

Program managers are reponsible for balancing the risks of cost, schedule, and performance to keep the program on track through to production and fielding. T&E in the SEP identifies risks and enables decision-making authorities to assess risk trade-offs.

Figure 2 provides detail on T&E as part of the SEP.

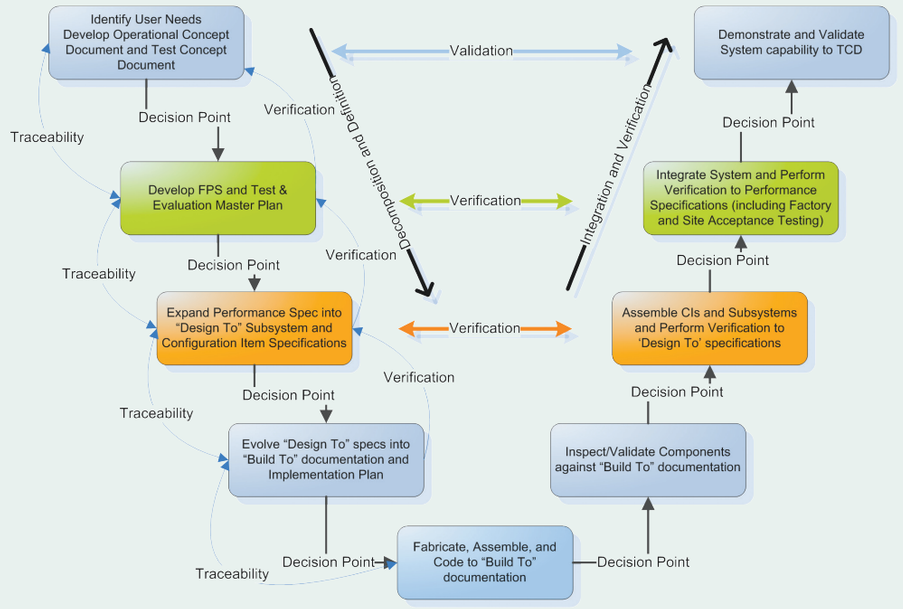

Figure 2: System Development V Diagram

T&E results feature prominently in the decisions reached at design and milestone reviews (decision points). However, the fact that T&E results are required at major decision points does not presuppose that T&E results must always be favourable. The final decision responsibility lies with the decision-maker who must examine the critical issues and weigh the facts. Only the decision-maker can determine the weight and importance that is to be attributed to a system's capabilities and shortcomings and the degree of risk that can be accepted. T&E provides the decision-maker with a solid base of information upon which to make these judgements.

The Cost Escalation Model articulates that the cost of correcting defects increases significantly the later in the life cycle that they are identified because of increasing system and sub-system complexity and integration.Because defects found earlier in the life cycle will cost significantly less to resolve than those identified later in the development process, T&E should be applied early in the system life cycle to help control system development costs.

Figure 3 shows the benefits of capturing defects early in the life cycle.

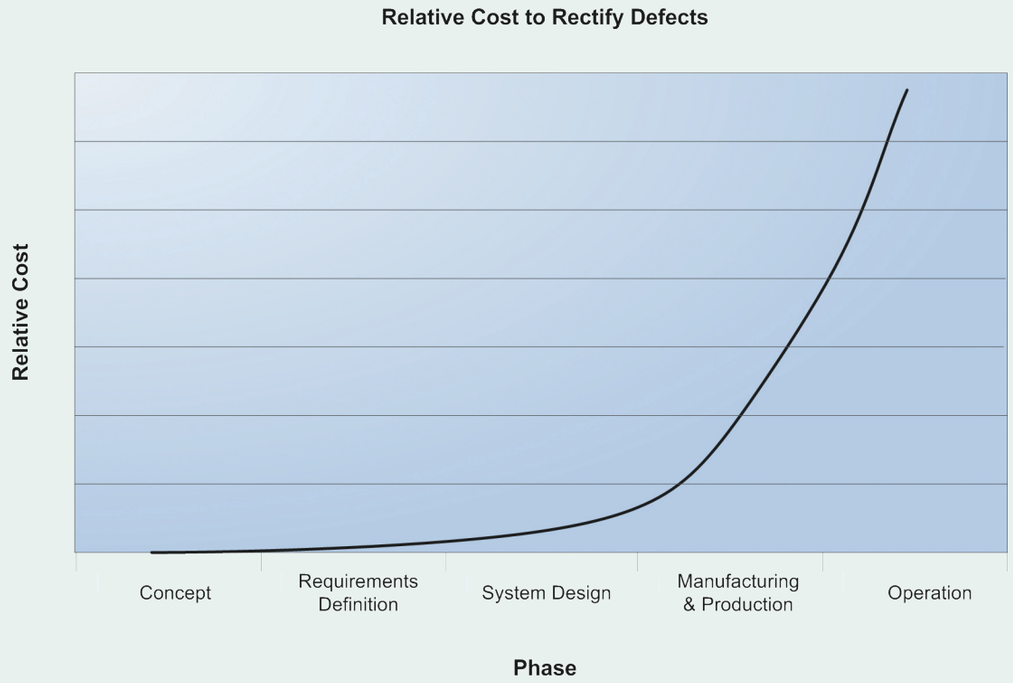

Figure 3: Life Cycle Cost Escalation Model

Source: Defence Materiel V&V Manual

CHAPTER 3 - WHY A T&E ROADMAP

The T&E Roadmap considers the current T&E policy, processes, organisation, and resources within Defence, and the future T&E required to facilitate the delivery of capability. The T&E Roadmap is applicable to both Major and Minor projects.

STRATEGIC GUIDANCE

There have been three main reviews and reports that provide strategic guidance and highlight the importance of T&E for Defence. They are the:

- Defence Procurement Review 2003;
- Auditor - General Audit Report No. 30 2001–2002; and
- Report on the Inquiry into Materiel Acquisition and Management in Defence – Foreign Affairs, Defence and Trade References Committee, March 2003.

Defence Procurement Review 2003

The Defence Procurement Review 2003, commonly known as the Kinnaird Report, reviewed issues associated with major Defence acquisition projects. The report included many recommendations for a new approach to Defence acquisition, and highlighted the need for T&E as an essential tool in the acquisition of Defence equipment to reduce risk, define technical limits and monitor contract performance and compliance.Significantly, the report stated that:

> *Greater resources need to be allocated to conduct comprehensive and rigorous T&E programs as part of project funding. Currently T&E is often not conducted in a comprehensive and systematic way for projects, and expertise available in Defence is not fully utilised. Although each of the Services undertakes varying degrees of T&E, these activities need to be integrated with the significant expertise and experience available in DSTO through the development of a T&E concepts document during second pass.*[1]

Auditor-General Audit Report No. 30 2001–2002

The individual Defence Groups have formulated their own policies, practices and personnel training. The ***Auditor-General Audit Report No. 30 2001–2002*** stated that Defence needs to promote a 'unified approach' to T&E to guarantee effective and efficient use of all T&E resources, to avoid unnecessary duplication of effort and resources. Accordingly, policies are being reviewed to implement how the 'unified approach' can be achieved. The Roadmap also calls for T&E resources to be costed, to assist in management and funding of T&E. In practice, the cost of the resources applied currently to T&E is generally inaccurately forecasted.

[1] *Defence Procurement Review 2003, p.20*

Report on the inquiry into materiel acquisition and management in Defence - Foreign Affairs, Defence and Trade References Committee, March 2003.

In Chapter 6 of its recommendations, the Senate Committee addressed Defence T&E as follows:

> *Successful project management demands successful risk management. Weapons platforms and support systems must be delivered to the specified levels of functionality and with safety-critical features assured. This can only be achieved if test and evaluation is given a prominent place in the management of capability development, acquisition and transition into service. The Committee is not completely satisfied that test and evaluation enjoys the status it deserves in capability development, and notes that a review of T&E policy is currently underway.*

T&E policy has since been amended by the Australian Defence Test and Evaluation Office (ADTEO).

Other Strategic Guidance

In addition to these reviews and audits a number of other internal Defence documents provide relevant information. These include:

- DCP 2006–2016;
- Defence Capability Development Manual;
- Network Centric Warfare (NCW) Roadmap 2007; and
- other Defence T&E Policies.

PART 2

THE EXISTING DEFENCE T&E ENVIRONMENT

CHAPTER 4 - CURRENT DEFENCE T&E

DEFENCE CAPABILITY PLAN 2006–2016

In the DCP 2006–2016 there are in excess of 130 Major projects. All of these projects, along with Minor and Rapid Acquisition projects, require T&E of varying degrees to inform the Capability Manager whether capabilities are operationally effective, suitable, sustainable, safe for intended use and environmentally compliant.

The DCP, in itself, is not a planning tool from a T&E perspective due to the nature of the document. The DCP provides brief detail on the Major Capital Equipment (MCE) proposals that are currently planned to go through the two-pass system during the document's period. The DCP is updated biannually and changes over time as Defence's priorities change. While the DCP provides a broad indication of future capability, it does not contain the level of fidelity required for detailed T&E planning purposes. This level of information is difficult to capture, but the ADTEO is now developing, on behalf of CCDG, a database to provide a consolidated view of strategic T&E requirements. This will enable future T&E resource planning and management. ***Figure 4*** shows a breakdown of T&E information on some significant Major projects listed in the DCP.

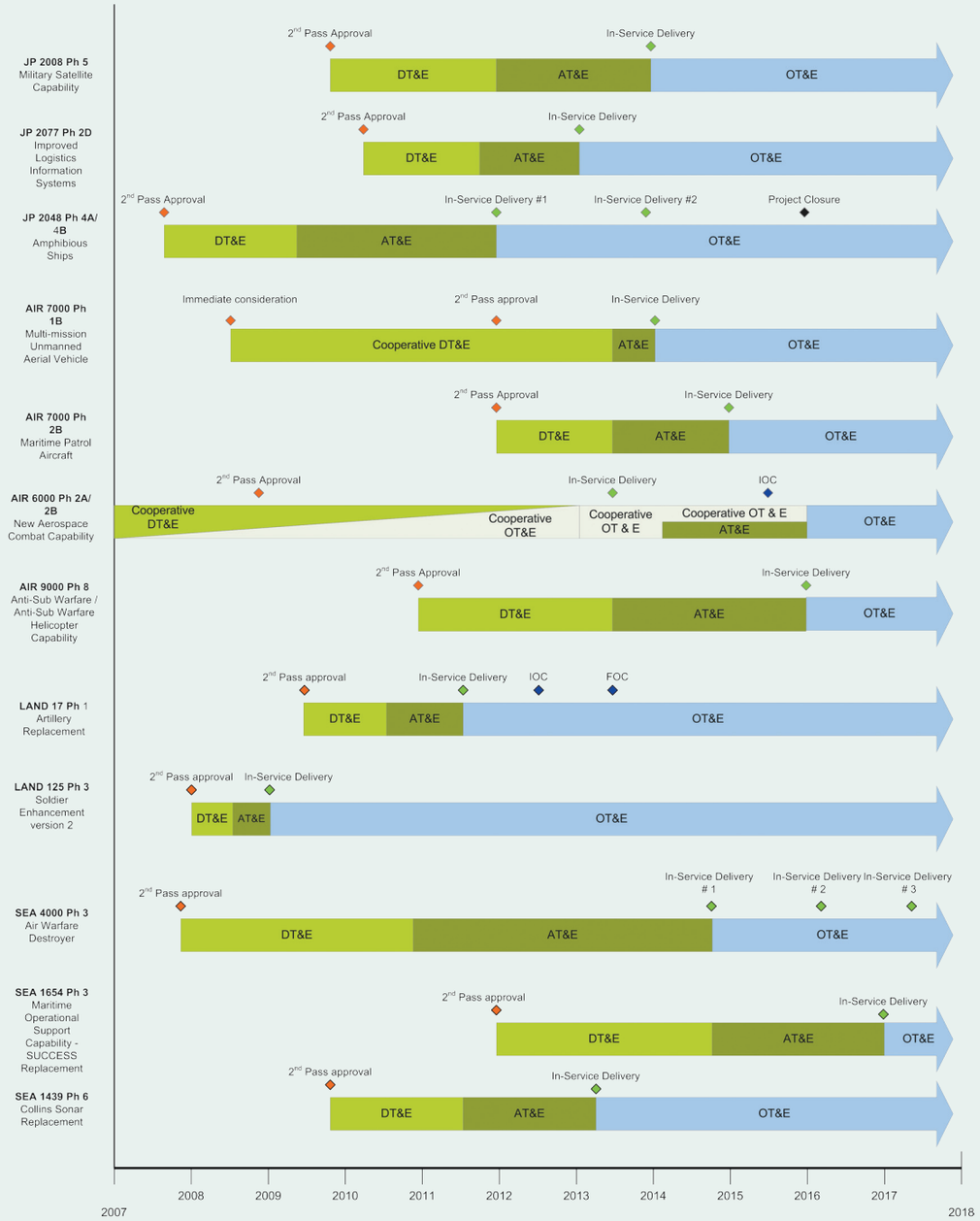

Figure 4: DCP Project T&E

The DCP indicates that there is a strong upward trend in Defence procurement spending for the next decade, which will have considerable effect on T&E resourcing, particularly for investment in both T&E personnel and facilities.

Financial analysis anticipates an expenditure of $6 billion on acquisition during the 2011–2012 financial year. The DCP indicates the breakdown of acquisition expenditure over the period of 2006–2016 is as follows:

- 46% on electronics;
- 26% on aerospace;
- 11% on maritime ;
- 10% on vehicles and land; and
- 7% on weapons and munitions.

These figures indicate that T&E needs to be reviewed at a Defence level to ensure appropriate levels of T&E resourcing are available to meet the substantial increase in expenditure. In particular, the increase in expenditure in electronics – as Defence moves to a network enabled force – is an important driver for change in the T&E community.

T&E AGENCIES AND FACILITIES

Currently T&E leadership, policy, management, coordination and guidance is provided by the ADTEO with T&E activities conducted by agencies at the Service/ Group level. Single Services have a role to play in T&E. Defence T&E roles and responsibilities are outlined in DI(G) OPS 43-1, *Defence T&E Policy*. Defence Trials in accordance with DI(G) ADMIN 06-1 are conducted by ADTEO.

There are a number of other stakeholders and enabling organisations within Defence T&E. These include Capability Development Group (CDG), Defence Support Group (DSG) and Joint Logistics Command (JLC), within Vice Chief of the Defence Force (VCDF) Group. Industry also has an important place within the Defence T&E community, through:

- contractors/suppliers that provide systems, conduct T&E and Verification and Validation (V&V) as part of the acquisition phase; and
- stand-alone test agencies (with specialist test facilities), that conduct tests and trials on behalf of Defence.

Many existing Defence T&E facilities are approaching (or have reached) the end of their useful life and without significant upgrade and investment, these facilities will be unable to adequately meet future weapon system or joint capability T&E requirements. Some T&E activities cannot be conducted within this country. The lack of indigenous missile ranges and targets, underwater testing and electronic warfare testing facilities, or guaranteed access to such overseas facilities has a major impact in assessing operational capability. Also, Defence cannot conduct Electro-Explosive Hazard (EEH) testing due to the lack of a suitable EEH Test Facility. Such a capability would enable the indigenous development of policy and materiel standards for explosive ordnance.

Presently there is no coordinated approach at a Defence level to identify T&E facilities necessary to support the DCP. Spending needs to be prioritised to ensure that the appropriate T&E facilities exist or are accessible via industry or overseas. Overall, T&E facilities need to be managed through establishment, upgrade and to eventual decommissioning.

Although Defence's T&E approach has previously been platform-based in single environments, achieving the FJOC will necessitate capabilities that routinely operate across platforms and environments. Accordingly, Defence will need to develop a T&E approach that enables the application and coordination of T&E across platforms and environments. ***Figure 5*** depicts a model for Defence's future approach to T&E.

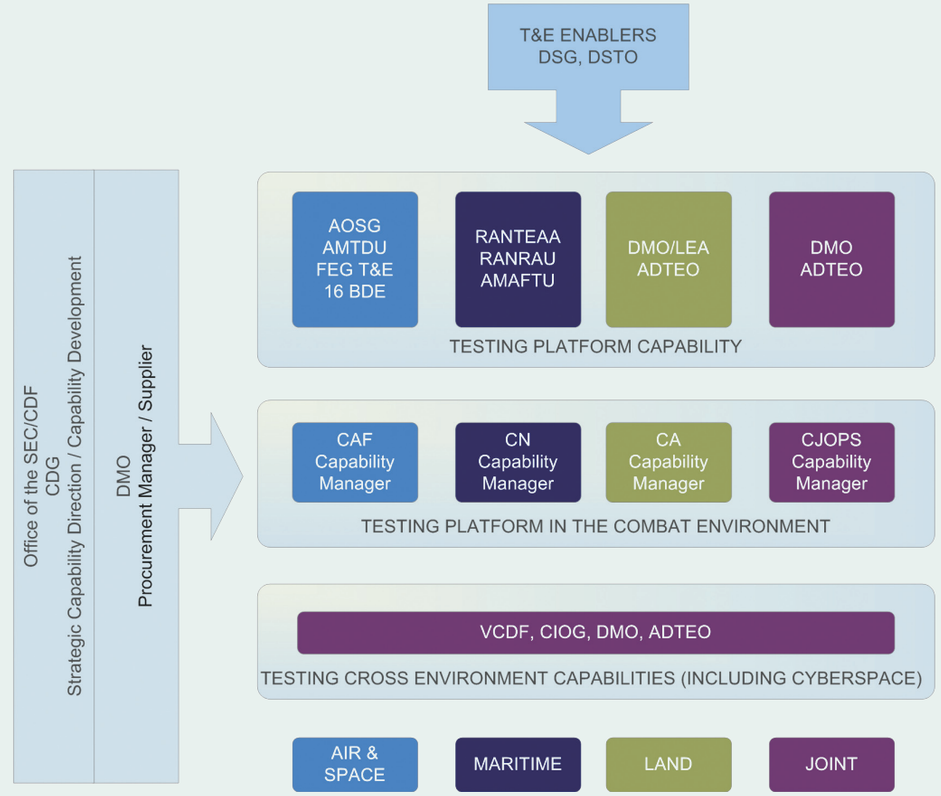

Figure 5: The Defence T&E Framework

CHAPTER 5 - T&E ISSUES

A number of current T&E issues and weaknesses have been identified from previous studies, reports and through engagement with the Defence T&E community. At the time of writing, a number of these issues remain outstanding. A summary of these issues follows.

Organisational Issues

Within Defence, there are a number of organisations that are responsible for the management and conduct of T&E activities. In relation to these organisations, the following issues have been identified:

- The extant organisations do not fully cover all of the current T&E requirements within the Capability Life Cycle.
- T&E responsibilities need to be clearly defined and enunciated so as to reduce the risk of nugatory duplication of T&E management, conduct and reporting. An example where this could potentially occur would be T&E for the MRH-90, an Army led acquisition of a platform which, once in service, is to be operated by both Army and Navy in different operating environments.

While Maritime and Aerospace T&E is generally well conducted, the Land environment does not have an organisation responsible for undertaking OT&E and acceptance into service. At the Combat Environment and Joint Force Operating levels, Defence lacks both organisations and resources to manage, coordinate and undertake T&E to ensure the integration of capabilities through a common methodology that is based on, and aligns with, relevant standards and procedures.

The lack of a standardised and coordinated approach to T&E within Defence, particularly across environments and at a joint level, means that it is difficult to identify the gaps to ensure that T&E is managed and conducted to an appropriate level to identify risk.

Industry Issues

Information to assist in the development and conduct of T&E activities is often difficult to obtain; this is often the case when the equipment is procured from foreign organisations. Such information is, nevertheless, an essential contract deliverable.

The current approach to T&E during the Acquisition phase often appears to have Industry performing T&E activities in isolation from the Commonwealth, which may adversely impact on the performance of the final capability. Early collaborative involvement of Commonwealth testing agencies in AT&E activities will ensure the T&E conducted is focussed on the critical operational issues.

Resource Issues

Financial

The Defence Capability Development Manual (2006) mandates the funding of OT&E and/or validation activities. However there are constant pressures on projects to under-resource these important activities. Additionally, funding for reworking and regression testing appears to be inadequate in many current projects. It is likely that this situation has arisen due to inexperience and understanding of the application and level of T&E resources necessary to successfully support projects.

The lack of adequate T&E funding may mean that not all deficiencies are identified through the design and build process, leading to potentially unsafe systems or shortfalls in capability performance which may lead to escalation in the cost of ownership.

A lack of historical data on the total costs of T&E for a capability program (across all stages of the capability life cycle) makes it difficult for project staff to estimate the T&E funding needed.

People

A number of people issues were identified during the development of this Roadmap, they include:

- Significant gaps in competency recognition, which potentially makes T&E less attractive than other career paths that offer formal qualifications and recognition.
- No formalised career management of personnel with T&E expertise and experience, which often means that skills and experience are ‘lost’ as staff move into new roles in non-T&E organisations.
- The majority of T&E training is conducted ‘on the job’ and staff turnover (especially with military members) results in people leaving the field before the value of their training can be realised.
- Military members raised concerns that were they to be ‘streamed’ into a specialist T&E path, their opportunities for further promotion may be limited.
- The aging workforce means there will be a period in the next 5 to 10 years where a number of T&E specialist personnel will retire from the workforce. A lack of effective succession planning will decrease Defence’s ability to provide sufficient T&E to meet capability needs. Currently 80% of Defence Materiel Organisation (DMO) technical officers are over 40 and 17% are over 55. The average age of an DMO engineer is 43 with 63% of engineers over 40 and 14% over 55[1].
- Difficulty in recruiting and retaining Technical Officers and Engineers. Currently in DMO Technical Officer positions are under filled by 27% and Engineer positions are under filled by 28%[1]. Given the forecast skills shortage it is likely that these figures will increase, potentially impacting Defence’s capacity to undertake T&E.
- There is limited – and in some instances, a complete lack of – T&E expertise in some specialist capabilities within Defence or Australian industry; for example, the skills to conduct large-scale joint OT&E or to operate an EEH Test Facility.
- Defence needs to identify the skills and expertise to adequately undertake T&E in emerging technological environments, including the threat of asymmetric weapons and so-called ‘disruptive’ technologies.

[1] DMO Engineering / Technical Job Family Workforce Analysis

Time

Traditionally project schedules for the delivery of capabilities are tight, placing pressure on all aspects of the project including the conduct of effective T&E, particularly the critical elements such as the testing of key FIC related elements pertaining to the measures of suitability. Because of these pressures, there is a temptation to allow inadequate time for the conduct of comprehensive T&E and the need for regression testing as a result of rework.

Schedule slippages impact heavily on T&E resource availability within the T&E agencies and these slippages often lead to planning issues at an agency level and resource clashes. Resource sequencing issues compound project delays, usually resulting in less T&E being conducted than was planned.

Currently, contract execution compels industry to focus delivery 'on time' and 'on budget'; there are no incentives to ensure the delivery of a product against the capability requirement and user needs, particularly in the rapidly changing technology environment. While the supplier must comply with contractual requirements, there could also be performance incentives associated with successful completion of OT&E activities of the contracted system.

Governance

It must be noted that the individual T&E agencies with limited resourcing have delivered quality T&E that has enabled capabilities to be delivered into service with minimum risk. However, this stovepiped approach will not be adequate to support CDF's vision for an ADF that is a '*balanced, networked, and deployable force, ...that operates within a culture of adaptability and excels at joint, interagency, and coalition operations.*' [1]

Despite a continual process of updating T&E policy and guidance, there are still some inconsistencies in policy and procedures between areas, which leads to inconsistent applications of T&E across Defence. Steps have begun to address this through the creation of the ADTEO and its mandate to provide Defence with a more strategic and cohesive approach to T&E. While the ADTEO will not exercise command or technical authority over other T&E organisations, it will undertake management and coordination at a joint level and undertake strategic planning to ensure resources are available for the other T&E organisations.

In the past, an Acceptance into Operational Service (AIOS) policy has been largely absent, and as a consequence AIOS has not been consistent across projects. AIOS policy documentation has now been developed and is detailed in DI(G) OPS 45-2, *Capability Acceptance into Operational Service*. While there are T&E agencies directly in support of the Capability Managers in the Maritime, and Air and Space environments who are involved in the AIOS process, there is no dedicated agency directly supporting this aspect for the Land environment.

[1] Joint Operations for the 21st Century, page 3

Process & Systems

It would be more efficient if Defence adopts a model where T&E subject matter experts are engaged during the concept and requirements development stage for each project to assist with the specification of project T&E requirements. Identifying problems earlier will reduce the cost of ownership. (Refer to ***Figure 3***)

The ADTEO has begun to develop processes to link forecast T&E requirements as described by project Test Concept Documents (TCD) with the development and maintenance of Defence T&E capability. The development of processes needs to:

- Encompass both Major and Minor projects. Presently many Minor projects introduce significant Command Control Communications Computers Intelligence Surveillance and Reconnaissance (C4ISR) capability or weapons systems upgrades to Defence, but are not generally subject to joint T&E before fielding.
- Monitor project progress to accommodate schedule slippage, scope change, project cancellation and short notice T&E requirements brought on by operational need. Many Defence projects include significant developmental risk that make long term T&E forecasting difficult.
- Assess the merits of developing and maintaining a particular capability domestically versus making use of international facilities. Consideration will be given to attracting international customers to Australian based T&E facilities (where there are no national security issues).
- Consider the appropriate level of centralisation of T&E governance and capability development. Many elements of the management and delivery of T&E capabilities are best decentralised. Environmental based T&E organisations, in particular Maritime and Air and Space, have highly developed platform level T&E capabilities that should be supported and nurtured by Defence. It would also make sense to allocate the lead responsibility for some elements of joint T&E to the existing environmental T&E organisations. However it is apparent that significant elements of joint T&E are not presently undertaken by Defence and do not easily exist within the remit of any particular environmental organisation – these should be managed centrally. As NCW concepts are embraced by Defence, the joint T&E requirement will grow to rival, or even overshadow, the existing environmental based T&E requirement.

Process and system development will take time, but is crucial to development of a mature Defence wide T&E capability. ADTEO should be adequately resourced and supported to ensure that these processes and systems are developed and implemented, to enable the conduct of joint T&E with multiple platforms and systems in the future.

CHAPTER 6 - FUTURE T&E ISSUES

The CDF's vision is for the ADF to be:

> *...a balanced, networked, and deployable force, staffed by dedicated and professional people, that operates within a culture of adaptability and excels at joint, interagency, and coalition operations.*[1]

In order to achieve CDF's vision, Defence has developed a FJOC, which provides an overarching concept for the ADF to be supported by concepts describing the ADF's operation in the three major combat environments: Maritime, Land, and Air and Space.

The FJOC is a component of the Strategic Planning Framework and is aligned with the current classified Defence Planning Guidance and the Defence Capability Strategy, which remain the guiding documents for capability developers. ***Figure 6*** describes the FJOC as part of the Defence hierarchy of concepts.

[1] *Joint Operations for the 21st Century, page 3*

A key enabler of the future balanced, joint, deployable, networked force is NCW. Network centricity will help Defence to link sensors, engagement systems, and decision makers into an effective and responsive whole.

With the emphasis on joint and coalition operations, the ADF could be well placed to leverage allied systems in operations. NCW seeks to provide the future force with the ability to generate tempo, precision and combat power through shared situational awareness, clear procedures, and the information connectivity needed to synchronise our actions to meet the commander's intent.

As noted in *Joint Operations for the 21st Century*, Defence may not always be the lead Government agency for dealing with security challenges. An integrated, multi-agency response approach will increasingly be a key to success in the future strategic environment, and so Defence will routinely work more closely with other Government departments, especially in area such as C4ISR. In any testing of capability that involves working with other Government departments, the ADTEO will be the Joint OT&E Program Manager.

The FJOC will drive the development of new capabilities, which in turn will drive systems complexity. The complexity of these new systems – coupled with cost constraints – will become key determinants in future acquisition policy and approaches.

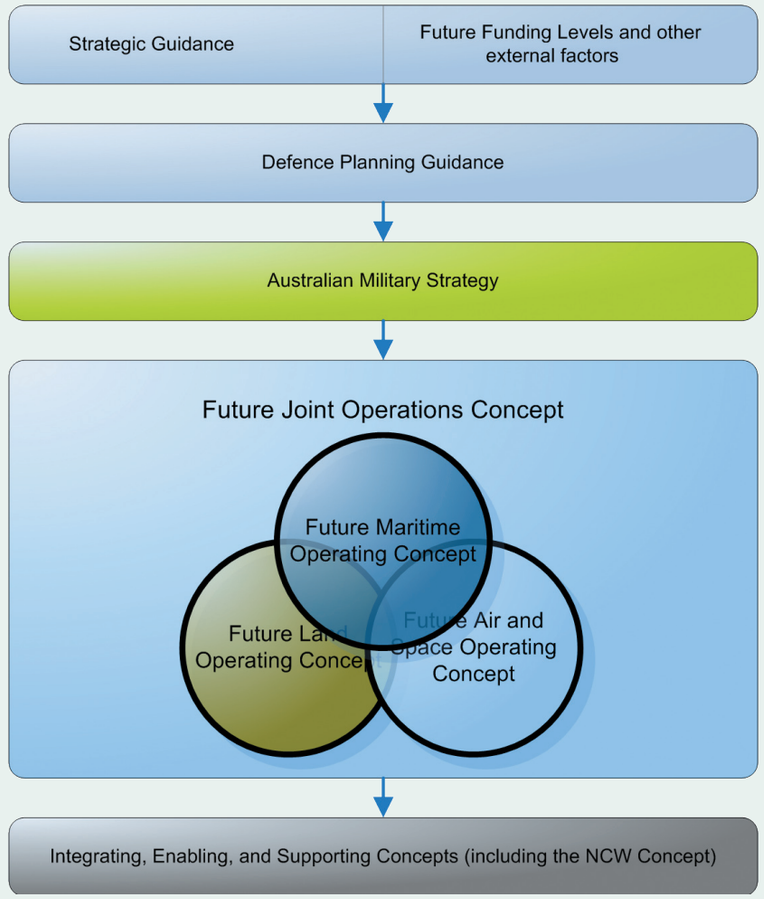

Figure 6: FJOC Hierarchy of Concepts

In order for the FJOC to be realised, each of the three combat environments – Maritime, Land, and Air and Space – must develop and deliver into service the appropriate capabilities to maximise their contibution to mission success in a variety of joint or coalition operations.

In parallel with the evolution of the FJOC is the evolution of T&E in order to address the complexities and risks associated with these joint, interagency integrated operations.

Accordingly, the remainder of this T&E Roadmap addresses not only the measures to overcome the current T&E issues, but also the conditions which need to be in place in order to manage and conduct T&E for the FJOC.

PART 3

THE FUTURE

CHAPTER 7 - FUTURE APPROACHES TO T&E

Traditionally in an ADF heavily weighted toward countering a conventional threat against Australian territory, T&E has mostly been applied at the platform level within the combat operating environments. As the ADF moves towards a hardened, networked, deployable joint force – characterised by adaptability and agility to handle the full range of military operations across the full spectrum of conflicts – there will be the need to respond to these technological challenges to facilitate this change. Increasingly, T&E will be used to identify integration risks between:

- platforms within each of the combat operating environments; and
- the Maritime, Land, and Air and Space combat environments in the conduct of joint, interagency or coalition operations.

Future T&E effort in Defence aims to ensure complex systems and capabilities are able to operate across each of the three combat environments within acceptable risk boundaries to achieve the operational requirements of the mission.

THE CHANGING TECHNOLOGICAL ENVIRONMENT

T&E requires a framework which will enable it to accommodate the complexity required for a balanced, networked and deployable force.

- **Revolutionary and Technological Change.** This is occurring on an exponentially growing scale, and demands that Defence institute a continuous transformation process to include all areas of doctrine, training, leadership, organisation, and technology. This technological change has two characteristics. First, it will include synergy of emerging technologies such as bio-engineering, nano-engineering, robotics and artificial intelligence. Second, it will occur at a speed never seen before.
- **Software Development.** A more systematic and rigorous approach to software testing is required. To be effective, this approach must be applied to all phases of the development process in a planned and coordinated manner, beginning at the earliest design stages and proceeding through to OT&E of the integrated system. This emphasis is driven by software developments of weapon systems, such as avionics systems, weapons targeting and control, and navigation computers. Standards for software development need to be tailored on a project-by-project basis to ensure T&E requirements are accommodated.
- **Testing of Electronic Combat (EC) and C4ISR Systems.** These systems pose unique problems for testers because of the difficulty in measuring their operational performance. Compatibility, interoperability, and integration are key performance areas for these systems. Special testing techniques and facilities are normally required in EC and C4ISR testing, such as shielded electronic chambers and threat generators, with a potentially heavy reliance on M&S.
- **Evolutionary Acquisition (EA).** Also known as spiral development, EA is a strategy designed to provide an early, useful capability even though detailed overall system requirements cannot be fully defined at program inception. The EA strategy contributes to a reduction in the risks involved in system acquisition, since the system is developed and tested in manageable increments. The C4I systems are likely candidates for EA because they are characterised by system requirements that are difficult to quantify or even articulate and are expected to change as a function of scenario, mission, theatre, threat, and emerging technology.

The challenge exists to ensure that T&E resources, systems and processes are sufficient to deliver capabilities into the future. Key to meeting this challenge is to ensure that T&E personnel are adequately educated, trained and skilled to apply T&E correctly in the changing technological environment.

FACTORS INFLUENCING THE WAY FORWARD FOR DEFENCE T&E

As Defence moves towards a complex, joint, NCW environment, a number of factors will impact on the level and amount of T&E required to ensure appropriate linkages exist between capabilities for joint operations, and risk is contained within acceptable boundaries. Factors driving the shape of T&E include:

- shortened life cycles of sub-systems, systems and even capabilities, as the rate of technology innovation continues to accelerate, will place greater burdens on the procurement system and its resources, which includes the conduct of T&E – the length of the procurement process means that sub-systems or systems may become obsolete prior to the capability being introduced into service;
- the increasing degree of NCW integration at all levels will increase the amount of practical T&E required and demand an ongoing requirement to develop new testing methodologies;
- the increasing complexity of technology – involving electronics, information communications technology (ICT) and processing power of components will place a greater reliance on software intensive systems;
- systems and solutions acquired to meet the challenges of this complex environment will have a higher degree of systems development and technological risk – increased capability complexity will increase the interaction and reliance on sub-systems and systems within platforms, which means that current test methods are likely to become obsolete;
- the disproportionate effect of relatively small sub-systems (particularly in ICT) on major platform integration;
- changes in strategic direction; and
- emerging asymmetric threats and non-traditional military scenarios.

Table 1 outlines a number of T&E considerations in a sample of non-traditional military scenarios.

Emerging Non-Traditional Warfighting T&E Concerns	T&E Objectives	T&E Issues / Requirements
Management Information and Communications Support Systems	Determine vulnerability of systems, under Electronic Warfare (EW) conditions.	Determine critical nodes in information transfer process. Define EW threats and engagement concepts. Establish equipment performance threshold criteria Identify means to intercept information transfer and processing.
	Evaluate means to enhance survivability of C4I systems by adapting design changes and process improvements Develop test data for V&V of modelling and simulation	Show impact of design changes / hardening on survivability improvements. Create knowledge base on phenomenology associated with coupling of electronic effects to C4I equipment. Determine sensitivity to countermeasures and engagement constraints.
Directed Energy Weapons (DEW) Systems	Determine susceptibility of combat systems to damage from DEW systems Develop data to support methodology for predicting DEW effects using M&S and test data.	Investigate compatibility of Electromagnetic Pulse (EMP) hardening for other DEW systems including RF and lasers. Expand knowledge base on coupling effects of DEW on combat systems. Determine sensitivity to countermeasures and engagement constraints.
	Establish bounds on lethality of DEW against threat combat systems.	Develop insights into utility of focussed non-nuclear EMP, RF weapons, and lasers against threat combat systems. Identify means to enhance performance of DEW against threat systems.
Robotic Combat Systems	Determine vulnerability of emerging combat systems to anti-armour robotic systems.	Evaluate implications of target size, mobility, and stealth capability to achieve target kills.
	Assess lethality of weapons against threat robotic systems.	Investigate options and techniques for defeating robotic threat systems with lethal and DEW systems.
Counter Terrorist Weapons	Determine capability of systems to withstand chemical/ biological attacks.	Translate threat scenarios into framework for test planning including simulations, burst locations from targets, and instrumentation Determine vulnerability of combat vehicle occupants as a function of test conditions and engagement parameters.
	Determine capability of ADF personnel to withstand chemical/biological weapons by onboard rapid detection and protective measures.	Assess utility of current and planned measures to protect personnel with detection devices and inoculation, protective clothing, overpressure, etc.
Improvised Explosive Devices (IED)	Determine capability of armoured & vehicle systems to withstand IED attacks Translate threat scenarios into framework for test planning including simulations, burst locations from targets, and instrumentation.	Determine vulnerability of combat vehicle occupants as a function of test conditions and engagement parameters. Determine capability of ADF personnel in vehicles to defeat IED attack by detection, protection and Tactics, Techniques & Procedures (TTP) measures. Assess utility of current and planned measures to protect combat vehicle occupants with detection devices, electronic/RF protection, protective clothing, safety systems, Automatic Fire & Explosion Suppression System (AFESS), etc. Determine effectiveness of system when employed utilising current or planned TTPs.

Table 1: T&E Considerations for Non Traditional Military Scenarios

COMPREHENSIVE T&E THROUGHOUT THE SYSTEMS ENGINEERING PROCESS

There is a need – based on the approach required to meet the complex, joint, NCW environment capability requirements – for T&E agencies and testers to have a joint T&E and platform integration focus, regardless of traditional organisational ties. Operational test agencies, Defence laboratories supporting DT&E , Industry design engineers, program managers, logisticians and users need to cooperate in order to achieve cost-effective solutions.This cooperation will be facilitated at the Defence level by the ADTEO, and at the system/platform level by Capability Systems and DMO.

T&E expertise must be included during program conception to ensure problems are identified and addressed early, rather than identified too late for meaningful and cost-effective changes to be made. T&E needs to provide an integrated continuum of supporting activities for systems engineering verification and operational performance exploration in realistic threat and environmental conditions. Systems Engineering and T&E Master Plans (SEMP and TEMP) need to be aligned with Capability Development Documents (CDD) in order to articulate this integration. The focus of individual tests, testing organisations, and recipients of their reports may be different, but the end goals should align towards expeditious introduction of cost effective capabilities to the warfighter. Whenever feasible, DT&E, AT&E and OT&E events as well as other T&E and V&V activities will be combined to make optimal use of resources. The operator should also be involved early in test planning to ensure the capabilities are delivered as intended.

POLICY AND GOVERNANCE

The ADTEO is reviewing all T&E policies, procedures and guidance in order to develop a standardised framework which ensures consistency and alignment at all levels across the operating environments, including FIC elements and cyberspace. The Roadmap does not seek to replicate this work. Additionally, this review will include all areas that undertake T&E.

An overarching T&E strategy flowing from the DCP should be developed to ensure future T&E resources are adequate to meet the DCP and the capabilities that will operate in the FJOC. ADTEO has commenced this work, and is best placed to coordinate this strategy development.

Specific T&E guidance should also be developed to provide greater assistance in the development of the T&E elements of contracts for MCE projects, as well as assisting CDG to ensure T&E aspects of Major projects are adequately resourced.

CAPABILITY DEFINITION PROCESS REVISION

Program managers are being tasked to provide complex capability systems to the user faster, with fewer resources, in compliance with more regulatory and statutory requirements.

Legacy acquisition processes bias T&E towards **design verification** through segmented contractor, developmental, live fire, and OT. With increasingly complex systems and greater cost constraints, T&E needs to transform into a truly integrated continuum of **requirements verification**, technology maturation, risk management, capability validation, and support assessment. This continuum should itself be interwoven at each iteration of the systems engineering process throughout the acquisition life cycle.

Accordingly, the capability development and acquisition processes (which include TCD preparation) require revision to ensure that TCDs both:

- evolve as a project progresses (addressing the various T&E activities to be undertaken during the life cycle stages); and
- are acted upon, to ensure that all necessary resources (including financial) are available for T&E as required.

These efforts will support long-term transformation, with a net effect of reducing total ownership costs while enabling more rapid fielding of needed capabilities through intelligent risk management.

RESOURCES

Professional T&E

T&E training is expensive and extensive; Defence should strive to retain its T&E personnel to facilitate successful delivery of capability. Members of the T&E community should be provided incentives to remain within that community. Motivation and incentives may need to be tailored for individuals, but options could include career paths and career management.

There is a need for a professional T&E association alignment to provide focus and forum for those involved with T&E in Defence. Such an association will provide the network to facilitate discussion along with distribution of T&E practices, principles and the review of the advancing technologies.

Facilities

An overarching Defence T&E facilities plan needs to be developed to ensure that both existing facilities and ranges such as Woomera and the Under Water Tracking Range are viable facilities into the future, and that new facilities, such as an EEH Test Facility – which will be needed for joint T&E – are established and equipped in appropriate timeframes. The EEH Test Facility has been recommended in ***ANAO Audit Report No 30 2002-2003 – 'Defence Ordnance Safety and Suitability for Service'***

Equipment

Policy, procedures and guidance (as necessary) need to be established to ensure T&E equipment is calibrated and maintained to required standards.

Whether as part of the overarching T&E Facilities Plan – or as a separate stand-alone document – planning should be undertaken to ensure the appropriate equipment is available when needed for particular testing programs. Such planning should consider the relative merits of Defence-owned and operated equipment, Industry-owned and Defence-operated equipment, or wholly Industry-owned and operated equipment.

Spectrum

The NCW Roadmap highlights that 'Radio Frequency (RF) spectrum is both a national and Defence asset'.[1] As RF spectrum is a finite resource, T&E RF requirements are becoming increasingly constrained by competing requirements. These competing requirements include the increase in bandwidth requirements of emerging weapons systems, the need to record telemetry from modern weapon systems for T&E purposes, as well as the encroachment by civil and commercial RF needs. Future communications planning needs to allow bandwidth for the transmission of T&E data during operations to enable the conduct of T&E to support operational activities.

Defence needs to adequately articulate its spectrum needs to CIOG, so that the Australian Communications and Media Authority (ACMA) understands Defence T&E requirements.

[1] NCW Roadmap 2007, Section 8-2

T&E ORGANISATION

In order to best coordinate T&E efforts, the ADTEO will be the central Defence T&E organisation that is responsible for the management and coordination of T&E functions across Defence (and through the various stages of the capability life cycle). The ADTEO's responsiblities include:

- The accurate forecasting of T&E through the Preliminary TCD (PTCD) and TCD; monitoring and coordination of realistic and efficient T&E through the Acquisition phase; and scheduling the conduct of realistic joint OT&E during the In-service phase.
- The coordination of Defence T&E facilities and ranges, to ensure that the appropriate and required T&E capabilities are available to meet future capability testing requirements. Given budgetary constraints, this may require oversight by a steering committee to agree on priorities.
- Maintenance and oversight of projects where T&E is conducted across environmental boundaries or of a joint operations nature.
- Through the TCD process, assigning 'lead agency' status to T&E organisations where the project crosses environmental boundaries.
- Assigning responsibility for the coordination and strategic management of Defence T&E personnel resources, to establish a competency framework and ensure testers are accredited.
- Oversight of T&E training across Defence.

A coordinated joint T&E approach should be developed for emerging joint capabilities. This can be facilitated through the ADTEO. Such an approach would take into consideration the synergies possible through coordination of the agencies involved in evaluating elements of these emerging capabilities. In light of this, existing T&E agencies and resources should be reviewed to identify gaps and overlaps.

PARTNERSHIPS

Defence should look to establish T&E relationships with Industry, allies and coalition partners to enable:

- the use of T&E results from external organisations to satisfy Defence T&E requirements (avoiding duplication in testing);
- world's best practices to be studied; and
- collaborative and reciprocal use of scarce facilities and ranges to avoid inefficient duplication where possible.

The development of the Woomera Test Facility into a world class T&E facility will encourage allied and coalition partners to utilise the facilities which in turn will increase international partnerships, allow for possible sharing of T&E data, assist in offsetting the costs of facility maintenance under a user pays model, and alleviate high costs in expensive overseas testing.

CHAPTER 8 - CONCLUSION

The Defence T&E Roadmap highlights the current T&E situation, the challenges facing T&E within Defence, and the actions necessary for Defence to ensure that it develops and maintains effective T&E to deliver future capabilities into service.

A coordinated T&E approach to delivering capability must be planned early and managed throughout the capability life cycle to ensure that capability outcomes are achieved.

To meet the challenges of the joint, complex technological future Defence T&E must:

- Centralise through the ADTEO (on behalf of CCDG) the coordination of all T&E resources, policy and processes to ensure the most efficient and effective application of T&E.
- Support projects to ensure that the planning and resourcing of T&E activities during a capability's life cycle are adequately addressed.
- Ensure that fielded systems are able to operate across platforms and environments to support future joint, interagency and coalition operations.

- Develop incentives for the suppliers of capability to deliver products that meet both the capability requirements and user needs, rather than just an 'on time' and 'on budget' approach.
- Support existing T&E agencies and stakeholders in their delivery of T&E by the provision of adequately skilled T&E professionals who are trained and equipped to meet emerging technologies in future capability systems.
- Centralise and coordinate the management of T&E facilities and equipment to ensure projects in the DCP can be delivered into service on time.

Through the continual delivery of quality T&E, the ADF will receive systems that meet operational requirements.This will ensure that the warfighter is best equipped for balanced, networked, and deployable operations across the full spectrum of conflicts.

T&E GLOSSARY

Term	Definition
Acceptance into Operational Service (AIOS)	The process by which the Fundamental Inputs to Capability (FIC) comprising a Capability System are proven to meet endorsed capability requirements, usually specified in an Operational Concept Document (OCD), and assembled such that in all aspects the capability has been realised and is acceptable for operational service.
Acquisition Phase	This is the third of the five-phase Defence capability life cycle. The Acquisition Phase is the process of procuring an appropriate materiel system to meet the identified requirements while achieving the best value for money over the life of the system.
Capability Baseline	The materiel system requirements defined by the Capability Definition Documents.
Capability Definition Documents (CDD)	The CDD define the Capability System baseline, and comprise the OCD, Function and Performance Specification (FPS) and the Test Concept Document (TCD).
Capability Manager (CM)	The role of the Capability Manager is to raise, train and sustain in-service capabilities through coordination of the FIC.
Capability System	The Capability System is the combination of the eight Fundamental Inputs to Capability which are the standardised elements required to delivery capability.
Contractual Delivery	Contractual Delivery occurs at System Acceptance is the physical movement of supplies from the contractor to Defence.
Critical Issues	Critical Issues are the issues deemed critical because any one, if not resolved, could lead to the failure of a materiel system to achieve Operational Release (OR). Critical Issues are usually categorised as either Critical Operational Issues (COIs) or Critical Technical Parameters (CTPs). COIs are the operational effectiveness and operational suitability issues that must be resolved in OT&E in order to determine that the system has the capability to perform its mission(s). CTPs are quantitative and qualitative test measurements of technical data that provide information on a system's performance.
Defence Trial	A Defence Trial is a Trial which is conducted by the ADTEO and is performed on capabilities and systems that require T&E that is independent of a group or single service.
Defence Trial Directive	A Defence Trial Directive implements a Defence Trial and is issued by the Trial Authority. The Directive specifies the Trial's aim and objectives, program, tasks, division of responsibility of participating authorities/agencies, safety, administrative and logistic arrangements, reporting and command and control requirements.

T&E GLOSSARY

Term	Definition
Defence Trial Report	A Defence Trial Report is produced by the ADTEO at the conclusion of a Trial, and is distributed in accordance with the requirements of the Trial Sponsor. – *note we use big T for Defence Trial, little t generic trial.*
Design Acceptance	Design acceptance certifies that a system is fit for service and poses no hazard to personnel, public safety or the environment.
Experimentation	The application of the experimental method to the solution of complex defence capability development problems potentially across the full spectrum of conflict types, such as warfighting, peace-enforcement, humanitarian relief and peacekeeping.
Final Operational Capability (FOC)	FOC is the point in time at which the final subset of a Capability System that can be operationally employed is realised. FOC is a capability state endorsed at project approval at Second Pass, and reported as having been reached by the CM.
Fundamental Inputs to Capability (FIC)	The standard list for consideration of what is required to generate 'capability', comprising organisation, personnel, collective training, major systems, supplies, facilities, support, and command and management. It is to be used by Defence agencies at all levels and is designed to ensure that all agencies manage and report capability, using a common set of management areas.
Initial Operational Capability (IOC)	IOC is the point in time at which the first subset of a Capability System that can be operationally employed is realised. IOC is a capability state endorsed at project approval at Second Pass, and reported as having been reached by the CM.
Initial Operational Release (IOR)	IOR is the milestone at which the CM is satisfied that the initial operational and material state of the Capability System – including any deficiencies in the FIC – are such that it is safe to proceed into a period of OT&E leading to an endorsed capability state.
In-Service Date (ISD)	ISD is the point in time that symbolically marks the beginning of the transition of a Capability System, in part or full, from the Acquisition Phase to the In-Service Phase. ISD coincides as closely as is practicable with IOR.
Latent Defect	A deficiency in design, materials or workmanship not discoverable by reasonable care or inspection prior to System Acceptance which causes a software failure, or a failure of supplies other than software which falls outside the incidence of random failures to be expected from those supplies.

T&E GLOSSARY

Term	Definition
Materiel System	A subset of the Capability System and is the combination of the Mission System and the Support System. The Materiel System covers those aspects of the FIC that are provided by the acquirer.
Measure of suitability	A parameter that describes the success or otherwise of a system being able to sustain its assigned role.
Measure of performance	A specific measure of a system's capability to which a numeric value can be assigned.
Measure of effectiveness	A parameter that describes the ability in which a system accomplishes its assigned role.
Mission System	That element of capability that directly performs the operational function, which includes platforms (eg ships, vehicles or aircraft), distributed systems (eg communications network), and discrete systems that integrate into other mission systems (eg radar).
Net Personnel and Operating Costs (NPOC)	NPOC is the difference between future and current mature operating costs associated with a capability, facility, system or specific item of equipment. It reflects the net difference between the cost estimates to operate a new, upgraded or replacement capability offset by the guidance (DMFP funding) available to operate the current capability, across all affected Groups.
Operational Capability (OC)	OC states are intermediate capability outcomes at the Project level, where required, between IOC and FOC. They are identified as Operational Capability 2, 3, etc (OC2, OC3).
Operational Concept Document (OCD)	The OCD is the primary reference for determining fitness for purpose of the desired capability to be developed, and is a complementary document to the Function and Performance Specification (FPS) and the Test Concept Document (TCD) which form the Capability Definition Documents (CDD) to define the Capability System baseline.
Operational effectiveness	The ability of a system to perform its intended function over its intended operational spectrum, in the expected operational environment, and in face of expected threats when operated by typical operational personnel.
Operational Release (OR)	OR is the acknowledgment by the relevant CM that a Capability System or subset, has proven effective and suitable for the intended role and that in all respects is ready for operational service.

T&E GLOSSARY

Term	Definition
Operational suitability	The capacity of the system, when operated and maintained by typical operational personnel in expected numbers, at the expected level of competency, to be reliable, maintainable, available, logistically supportable, compatible, interoperable, safe and is ergonomically satisfactory.
Operational T&E (OT&E)	T&E conducted under realistic operational conditions to demonstrate that a capability is safe, suitable and effective for its intended role. OT&E is conducting with representative users of the system, in the expected operational context, for the purpose of determining its operational effectiveness and suitability to carry out the role and fulfill the operational needs that it was intended to satisfy.
Originator	The agency requiring a Defence Trial.
Rapid Acquisition (RA)	RA is a method of quickly overcoming recognised operational deficiencies in order to meet immediate security challenges.
Support System	The Support System is the sum of the existing support infrastructure and the additional support elements being generated under the contract to enable the Mission System to be effectively operated and supported to meet its operational requirements.
System Acceptance	System Acceptance is the acknowledgment by the DMO project authority that an acquired materiel system complies with contractual and single service requirements and is ready to be transitioned to the In-Service Phase.
System Specification	The System Specification defines the validated requirements for the system, and the contractor and the Commonwealth use it as the basis for common understanding of the system technical requirements.
Test and Evaluation (T&E)	T&E is a process to obtain information to support the objective assessment of a Capability System with known confidence, and to confirm whether or not a risk is contained within acceptable boundaries across all facets of a system's life cycle. The individual terms are defined as: a test is an activity in which a scientific method is used to obtain quantitative or qualitative data relating to the safety, performance, functionality, contractual compliance, and supportability of a system; and evaluation is analysis of test results to determine (verify) or prove (validate) something.

T&E GLOSSARY

Term	Definition
T&E Master Plan (TEMP)	The TEMP is the plan for traceability between T&E activities and the endorsed Critical Issues, to further ensure that only the required testing is undertaken. Results of T&E planned in the TEMP are used to provide proof that new or upgraded capability meets its baseline, is safe and fit for purpose throughout its life cycle.
Trial	A trial is defined as an activity to establish the performance and/or characteristics of an equipment, system or concept against a specification or approved capability. In this context, a trial usually takes the form of a planned process aimed at exercising the trial item in its actual or simulated environment to produce data for evaluation. Information derived from analysis of the data is then presented in the form of a report for consideration in the higher decision making process.
Trial Agency	Any organisation, unit or laboratory with a responsibility for implementing the Defence Trial Directive in whole or in part is termed a Trial Agency. For some trials, more than one Trial Agency may be involved. The Defence Trial Directive will clearly define the division of responsibilities.
Trial Authority	The Director General Test & Evaluation (DGT&E) is the Trial Authority for Defence Trials.
Trial Manager	The Trial Manager is the Australian Defence T&E Office (ADTEO) staff member, named in the Defence Trial Directive, who is responsible for management of the Defence Trial.
Trial Sponsor	The Trial Sponsor is the appointment in Defence responsible for initiating and funding a trial.
Trial Support Agency	Any organisation, unit or laboratory with a responsibility for supporting a Defence Trial is termed a Trial Support Agency. For some trials, more than one Trial Support Agency may be involved. The Defence Trial Directive will clearly define the division of responsibilities.
Validation	Proof through evaluation of objective evidence that the specified intended end use of a product or system is accomplished in an intended environment.
Verification	Confirmation by examination and provision of objective evidence that specified requirements to which a product or service, or aggregation of products and services, is built, coded, assembled and provided have been fulfilled.

T&E ROADMAP ABBREVIATIONS

Abbreviation	Definition
ACMA	Australian Communications and Media Authority
ADF	Australian Defence Force
ADTEO	Australian Defence Test & Evaluation Office
AFESS	Automatic Fire & Explosion Suppression System
AIOS	Acceptance Into Operational Service
AMAFTU	Aircraft Maintenance and Flight Trials Unit
AOSG	Aerospace Operational Support Group
AT	Acceptance Test
AT&E	Acceptance Test and Evaluation
C4ISR	Command Control Communications Computers Intelligence Surveillance and Reconnaissance
CCDG	Chief Capability Development Group
CDD	Capability Development Documents
CDG	Capability Development Group
CDF	Chief of the Defence Force
CIOG	Chief Information Officer Group
DCC	Defence Capability Committee
DCP	Defence Capability Plan
DCDM	Defence Capability Development Manual
DEW	Directed Energy Weapons
DMO	Defence Materiel Organisation
DSG	Defence Support Group
DSTO	Defence Science and Technology Organisation
DT	Development Test
DT&E	Development Test and Evaluation
EA	Evolutionary Acquisition

T&E ROADMAP ABBREVIATIONS

Abbreviation	Definition
EC	Electronic Combat
EEH	Electro-Explosive Hazard
EMP	Electromagnetic Pulse
EW	Electronic Warfare
FIC	Fundamental Inputs to Capability
FJOC	Future Joint Operating Concept
FPS	Function and Performance Specification
JE	Joint Experimentation
JLC	Joint Logistic Command
ICT	Information Communications Technology
IED	Improvised Explosive Devices
M&S	Modelling and Simulation
MCE	Major Capital Equipment
NCW	Network Centric Warfare
OCD	Operational Concept Document
OT	Operational Test
OT&E	Operational Test and Evaluation
PTCD	Preliminary Test Concept Document
RAAF	Royal Australian Air Force
RF	Radio Frequency
SEMP	Systems Engineering Master Plan
SEP	Systems Engineering Process
TCD	Test Concept Document
TEMP	Test & Evaluation Master Plan
TTP	Tactics, Techniques & Procedures
V&V	Verification & Validation

DEFENCE T&E AGENCIES, RANGES AND FACILITIES

Defence has a number of test agencies, ranges and facilities that are utilised in the delivery of T&E, and are tabulated here for convenient reference. Defence T&E can be carried out in Defence Training Areas (TAs) depending on the nature of the T&E. The list and management of Defence TAs is detailed in DI(G) ADMIN 59-1, *Management of Defence Training Areas*. **Category 5** TAs are T&E ranges which are dedicated principally to the testing of equipment, equipment systems and ammunition. All TAs are to be declared a Defence Practice Area if the T&E activity or facility poses a risk to public safety. The primary Category 5 ranges are tabled below.

NAME	OWNER	T&E Function
Australian Defence T&E Office (ADTEO)	CDG	The ADTEO is the Defence authority for T&E. The ADTEO provides advice and consultancy on T&E issues, and services for managing joint and single-Service trials in support of T&E activities.
Aerospace Operational Support Group (AOSG)	RAAF	Aircraft Systems Test Squadron: responsible for the planning and conduct of T&E of RAAF and Army state aircraft and associated systems. Aircraft Stores Compatibility Engineering Agency: responsible for the clearance of compatible State aircraft stores configurations associated with the safe and effective carriage, employment and jettison of stores from all ADF State aircraft. Aerospace Systems Engineering Squadron: responsible for engineering Systems Design and Development. Joint Electronic Warfare Operational Support Unit: responsible for Operational Support of all ADF aerospace EW. Woomera Test Facility: maintains and operates instrumentation primarily from the Woomera Air Weapons Range for the collection of aerospace and weapons performance data during T&E.
Air Movements Training and Development Unit (AMTDU)	RAAF	Undertake trials and tests for new air movement and aerial delivery equipment. Conduct trials of Army air transportable equipment and RAAF equipment requiring air movement. Conduct trials and recommend standard procedures and methods for the carriage of internal and external loads by helicopter.

DEFENCE T&E AGENCIES, RANGES AND FACILITIES

NAME	OWNER	T&E Function
Aircraft Maintenance and Flight Trials Unit (AMAFTU)	RAN (Fleet Commander through COMAUSNAVAIRGRP)	Flight testing of naval aircraft prior to and following modification. Evaluation of the suitability of new or modified equipment for service. Flight testing of naval aircraft role equipment. Determining safety limits for aircraft landing on and taking off from ships.
DSTO Intelligence, Surveillance and Reconnaissance Division	DSTO	Conducts research and development in airborne and surface radar systems, conducts radar and electromagnetic measurements.
DSTO Weapons System Division	DSTO	The Systems Simulation Centre carries out T&E of military and other equipment, primarily by use of hardware-in-the-loop techniques, in which equipments and sub-systems are tested in real-time simulations of their operating environments.
DSTO Maritime Platforms Division	DSTO	MPD manages a number of test sites at which products and materials can be tested for durability in extreme conditions. Temperature, humidity, ultraviolet radiation, organic action, salt spray and marine immersion are only a few of the hazards to which materials can be subjected.
DSTO Air Vehicles Division	DSTO	Aircraft structural testing is conducted in two large laboratories. Smaller scale metal and composite components and test specimens are tested in smaller testing facilities.
Jervis Bay and Mobile Telemetry Data Acquisition Facilities	RAN (RANRAU)	A fixed facility at Jervis Bay and a mobile facility serve as ground based telemetry receiving, processing, analysis and display systems for the testing of RAN and RAAF missiles.
Joint Proof & Experimental Unit (JPEU)	VCDF (JLC)	The JPEU is responsible for conducting dynamic, static and environmental tests and trials of components or complete systems of explosive ordnance (EO), non-EO and other items to support Defence and external clients.

DEFENCE T&E AGENCIES, RANGES AND FACILITIES

NAME	OWNER	T&E Function
Land Engineering Agency (LEA)	DMO	LEA has extensive facilities and equipment for performance measurement and environmental testing of Land Materiel.
Magnetic Measurement Range (MMR) HMAS STIRLING	RAN	The MMR provides measurement, data processing and analysis of magnetic fields associated with Steel Hulled vessels and Submarines.
Proof and Experimental Establishment Port Wakefield	VCDF (JLC)	Long range testing and measurement of ballistic performance of large calibre weapon systems as well as environmental and non-destructive testing of explosive ordnance.
Proof and Experimental Establishment (P&EE) Graytown	VCDF (JLC)	Offers a soft recovery technique known as Vertical Recovery, in which projectiles are fired almost vertically and subsequently recovered from the soil. P&EE Graytown's capabilities include the Small Arms Test Centre and Munitions Test Centre at Benalla and the Small Arms Test Centre at Mullawa.
Shallow Water Sound Range Jervis Bay	RAN (RANRAU)	Conducts underwater radiated noise measurements on RAN vessels.
Sydney Harbour Degaussing Range Facility	RAN	Provides measuring, data processing and analysis of magnetic fields associated with steel-hulled surface vessels, submarines and Mine Counter Measures Vessels.
Under Water Tracking Range (UTR) HMAS STIRLING	RAN	The UTR is used for real-time measurement of surface and underwater vehicle dynamic performance, sensor alignment trials and weapon system trials. Additionally the UTR enables air, surface and sub-surface participants to conduct Torpedo Firing Exercises and practices.
Woomera Test Facility (WTF)	RAAF (AOSG)	The WTF is a test facility administered by AOSG. WTF activities are coordinated by WTF planning staff and can, at any time, use part or all of the Woomera Prohibited Area (WPA).