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Performance Audit

Remediation of the Lightweight Torpedo Replacement Project

Department of Defence
Defence Materiel Organisation

Australian National Audit Office

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Australian National Audit Office

Canberra ACT
28 February 2013

Dear Mr President
Dear Madam Speaker

The Australian National Audit Office has undertaken an independent performance audit in the Department of Defence and the Defence Materiel Organisation with the authority contained in the *Auditor-General Act 1997*. I present the report of this audit to the Parliament. The report is titled *Remediation of the Lightweight Torpedo Replacement Project.*

Following its presentation and receipt, the report will be placed on the Australian National Audit Office's Homepage—http://www.anao.gov.au.

Yours sincerely

Ian McPhee
Auditor-General

The Honourable the President of the Senate
The Honourable the Speaker of the House of Representatives
Parliament House
Canberra ACT

AUDITING FOR AUSTRALIA

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Abbreviations

ADF	Australian Defence Force
AT&E	Acceptance Test and Evaluation
AWD	Air Warfare Destroyer
CDG	Capability Development Group
DMO	Defence Materiel Organisation
DOR	Detailed Operational Requirement
DSTO	Defence Science and Technology Organisation
FFG	Guided Missile Frigate (Adelaide Class)
FFH	Frigate Helicopter (ANZAC Class)
FOC	Final Operational Capability
FPS	Function and Performance Specification
FRAA	Further Revised Alliance Agreement
IMR	Initial Materiel Release
IOC	Initial Operational Capability
IP	Intellectual Property
JP	Joint Project
MAA	Materiel Acquisition Agreement
NAXA	Northern Australia Exercise Area
OEM	Original Equipment Manufacturer
OT&E	Operational Test and Evaluation

PDT	MU90 Practice Delivery Torpedo
PEF(M)	Post Exercise Facility (Mobile)
PMSG	Project Management Stakeholder Group
OQE	Objective Quality Evidence
RANTEAA	Royal Australian Navy Test Evaluation and Acceptance Authority
SLWTS	Surface Lightweight Torpedo System
SVTT	Surface Vessel Torpedo Tube
TC	MU90 Warshot Torpedo
TEMP	Test and Evaluation Master Plan
TIAP	Technical and Industrial Action Plan
TMF	Torpedo Maintenance Facility
TVE	MU90 Exercise Torpedo
VCRM	Verification Cross Reference Matrix
WAXA	Western Australia Exercise Area

Summary and Recommendations

Summary

Introduction

1. The Australian Defence Force's (ADF's) primary anti-submarine capability is provided by its maritime patrol aircraft, frigates and naval combat helicopters, and the lightweight torpedo is the main anti-submarine weapon deployed on these platforms.[1] The Department of Defence's (Defence's) Joint Project 2070 (JP2070) is replacing the ADF's existing ship launched anti-submarine weapon (the Mk46 lightweight torpedo) with a new generation torpedo (the MU90 lightweight torpedo). The project currently has a budget of $639 million and involves the procurement of a number of MU90 lightweight torpedoes (the exact number is classified), associated support systems, and the integration of the torpedo with the Adelaide Class Guided Missile Frigates (FFGs) and the ANZAC Class Frigates (FFHs, more commonly referred to as ANZAC Ships).[2]

2. In light of the expansion and technological advancement of potential submarine threats, in July 1997 Defence determined that the ADF's Mk46 torpedo had significant limitations, was not adequate for the ADF's needs, and that a new torpedo should be acquired.

3. JP2070 was established in February 1998. The project originally planned to also integrate the new torpedo with the following aircraft: the AP-3C Orion maritime patrol aircraft, the Seahawk helicopters and the Super Seasprite helicopters. However, the Australian Government cancelled the failed project to acquire the Super Seasprites in March 2008, and removed the AP-3C Orion and Seahawk from the project's scope in February 2009 because of cost and technical pressures.

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1 Anti-submarine warfare (operations conducted with the intention of denying the enemy the effective use of their submarines) is an important capability in the defence of a maritime nation such as Australia, and lightweight torpedoes are a critical element of anti-submarine warfare. Lightweight torpedoes are self-propelled, underwater projectiles that can be launched from ships and aircraft and are designed to detonate on contact or in close proximity to a target.

2 Under a separate project (SEA4000 Phase 3), Defence is currently acquiring three new Hobart Class Air Warfare Destroyers (AWDs). Defence plans to progressively withdraw the FFG fleet between 2014 and 2019, replacing them with the AWDs. The MU90 is being integrated onto the AWDs as a ship launched torpedo, although this is being managed by the AWD project.

4. Defence is acquiring four versions of the MU90: for combat (known as the warshot torpedo), exercise and practice firings, and training. The exercise version is created by substituting the warhead with an exercise section, which records the torpedo's in-water performance. The practice version is not propelled, but can record weapon firing data, allowing lower cost training for personnel. A 'dummy' version is used to train personnel in handling and loading/unloading operations at minimal cost.

5. The project is managed by the Guided Weapons Branch within the Explosive Ordnance Division of the Defence Materiel Organisation (DMO). Early on in the project, Defence decided to adopt an alliance contracting model for the project. The Alliance, known as the 'Djimindi Alliance', comprises the Commonwealth of Australia, Thales Australia and the Eurotorp European Economic Interest Group (Eurotorp), which developed the MU90. While the project is still being delivered by the Djimindi Alliance, since 2005 it has operated within a revised contract, which includes features of a more traditional contract.

6. Given the importance of the anti-submarine warfare capability to the ADF, the ANAO has previously audited Defence's progress in acquiring and introducing into service the replacement lightweight torpedo. Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project* was released in May 2010. That audit concluded that JP2070 was a complex project that needed appropriate risk management to address the project risks and effectively complete the project. However, at the time there were significant weaknesses in Defence's risk management of the project. The key areas of risk that had emerged or gained increasing significance over the life of the project included:

- The initial costing of JP2070 was not sufficiently rigorous or subject to adequate scrutiny.
- Project planning and management was inadequate, and in some instances key project documents were either not developed or were not developed on a timely basis.
- The decision to use alliance contracting arrangements for JP2070 was not based on structured analysis of contractual options, and once implemented was not adequately supported.

- An inadequate understanding of the weapon and in particular its development status over the period 1999 to 2004 contributed to an underestimation of project risk.[3]
- The risk involved in integrating the weapon onto multiple platforms was acknowledged, but not fully appreciated at the outset, and was compounded by a range of factors as JP2070 progressed.
- The planning of testing and acceptance, and the resolution of testing and acceptance issues for JP2070, by DMO had been inadequate.

7. The previous audit assessed JP2070 against the fundamental purpose of a major capital acquisition—the provision of a new or enhanced capability to the ADF, to schedule and within the approved budget—and found that the project had not been managed effectively, as it:

- would not deliver the capability originally sought;
- had not achieved schedule; and
- had remained within budget only by removing from the project's scope three of the five platforms that were originally intended to be integrated with the torpedo.[4]

8. At the time that audit report was released, substantial work was required to remediate the project and deliver the required capability. Subsequently, the then Minister for Defence, Senator Faulkner, wrote to the Auditor-General requesting that the ANAO undertake a follow-up audit of JP2070 within 12 to 18 months following the previous audit. The Auditor-General agreed to the Minister's request and scheduled this audit, which commenced in late 2011. Additional time has been required to complete this

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[3] During this time, Defence and DMO believed the MU90 to be an off-the-shelf torpedo that was already in-service with the other navies. This was not the case: it was a developmental torpedo. Subsequently, issues identified through production testing of the torpedo contributed to schedule slippage and invalidated planning assumptions with ongoing implications for testing and evaluation.

Throughout the proposal evaluation and selection process in 1999, the 'off-the-shelf' and 'in-service' nature of the MU90 was cited repeatedly as the most significant reason for it succeeding over the nearest contender. For example, the findings of the Operations and Engineering Proposal Evaluation Working Group and the Business and Finance Proposal Evaluation Working Group, as summarised in the October 1999 Source Evaluation Report, refer to the MU90 as proven, extensively tested, and the only off-the-shelf product offered in the four proposals received.

The MU90 was first accepted into operational service by the French Navy in February 2008.

[4] ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, pp. 15-17.

audit in order to take proper account of the work Defence has been undertaking in this project over recent times and the progress achieved.

Current audit approach

9. The objective of the current audit was to assess the effectiveness of remediation arrangements put in place by Defence and DMO to resolve issues impacting on the achievement of the desired lightweight torpedo capability. The scope of the audit covers progress made in delivering the capability since the completion of the previous audit. It focuses on project management and contractual arrangements, and the progress made with platform integration and test and evaluation.

10. To assess the effectiveness of project remediation since the previous audit, the audit focussed on whether:

- remediation plans were appropriately documented, endorsed and followed;
- project progress is being effectively monitored, and key stakeholders are informed on progress, including the Government;
- platform integration has progressed according to plan;
- operational test and evaluation processes are ongoing, are based on validated plans, and there was a stakeholder endorsed transition from acceptance test and evaluation to operational test and evaluation; and
- progress has been made towards the achievement of an endorsed Initial Operational Capability (IOC), which at the time of the previous audit was planned to occur in mid 2011, with a clear path forward towards achieving Final Operational Capability (FOC) by mid 2013.[5]

11. Audit fieldwork involved interviewing personnel, site visits and examining documentation collected from various groups within Defence.

[5] IOC is the point at which the Capability Manager declares that the first subset of a capability can be operationally employed. Defence defines IOC for the MU90 as the capability to fire MU90 torpedoes from one FFG and one FFH, including: all onboard weapon handling and storage systems; the delivery of all integrated logistics support requirements; and the ability to conduct OT&E anywhere on the Australian station.

FOC is the point at which the Capability Manager declares that the final subset of a capability can be operationally employed.

Overall conclusion

12. JP2070 is a complex project with a current budget of $639 million. After the project is completed, the MU90 is planned to remain in service until 2038. As a maritime nation, having an effective anti-submarine warfare capability is an important requirement for the defence of Australia. In the 2009 Defence White Paper, the Australian Government identified anti-submarine warfare as a key capability priority for modernising and enhancing the ADF.[6]

13. At the conclusion of the ANAO's 2009–10 audit of JP2070, Defence was making significant effort to remediate and progress the project, with the intention of achieving IOC by mid 2011 and FOC by mid 2013. Further technical difficulties were encountered in 2010, which led to some additional schedule delay. Consequently, IOC was not achieved until November 2012. Defence expects to achieve FOC by mid 2013.

14. Over the last year in particular, several important milestones have been met. Defence has been effective in progressing JP2070 to the point where there is now a clear path to completion of the project's current scope. In particular, a platform integration solution has been developed which can be rolled out across the FFG and ANZAC ship fleets as the platforms become available for fit-out, which is planned to be completed by mid 2013. Test and evaluation progressed from acceptance to operational test and evaluation (OT&E), with the planned OT&E firings almost complete (with the exception of a warshot firing planned for mid 2013).

15. Defence's increased focus and effort on JP2070 was evident in the response to failed test firings in November 2010. These firings uncovered several defects with the torpedo system, which had not been identified previously because of limited test firings. Resolution of these issues was critical if the project was to proceed to IOC. Defence developed potential solutions, and developmental testing was subsequently undertaken in mid 2011 to test the solutions. These firings used a wharf-mounted torpedo tube that fired into a recovery device, allowing multiple firings in short succession without the need to utilise Navy resources or refurbish the practice torpedo. This was a cost-effective and practical approach which enabled DMO to gain confidence that defects had been largely overcome before undertaking testing aboard a Navy ship to confirm resolution of the issues.

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[6] Department of Defence, *Defending Australia in the Asia Pacific Century: Force 2030*, pp. 70 & 72.

16. Defence has made substantial progress in recent times towards the successful introduction into service of the MU90 capability for relevant Navy surface platforms. However, there are a range of issues which will impact on this capability over its life cycle:

- The Commonwealth has limited Intellectual Property access rights for torpedo components and support equipment (such as the simulator and torpedo test equipment). This will limit Defence's options for future modifications and upgrade.
- The MU90 simulator acquired by Defence does not fully meet Defence's formal requirements, and there are questions relating to its long term viability for supporting training, technical and tactical development, as the version procured cannot be networked with other Defence simulators and there are also uncertainties over its long-term support.[7]
- Defence was unable to obtain sufficient evidence to verify over two-thirds of the warshot torpedo's performance requirements prior to the conduct of OT&E. This resulted in Defence approving deviations and waivers to specified requirements and the need for OT&E to also verify lower level acceptance testing. Waived requirements will not be verified.[8]
- Following the May 2011 decision to acquire the MH-60R Seahawk *Romeo* as the ADF's new maritime helicopter, the ADF will be obliged to manage a mixed inventory of very different lightweight torpedoes into the long term.[9] Defence is yet to fully define either the whole-of-life-cycle costs of maintaining the MU90 inventory or the costs and

[7] Mainly concerning: future technical support, hardware obsolescence due to the rapid evolution of computer platforms, and the inability to modify the simulator due to a lack of access to background IP. The company that supplies the simulator and support, WASS, is an Italian company with no Australian presence.

[8] Where DMO determines that requirements specified in capability definition documents are unable to be met or tested, DMO is required to obtain waivers from both Capability Development Group and the capability manager, which removes the requirements from testing.

[9] The four Adelaide Class (FFG) and eight ANZAC Class (FFH) ships will operate the MU90. The AP-3C Orion aircraft that were originally to have the MU90 integrated onto them will continue to use the ADF's existing Mk46 until they are eventually replaced by the Poseidon P-8A maritime patrol aircraft, currently planned to enter service between 2017 and 2020. Both the Poseidon and the MH-60R Seahawk *Romeo* helicopter (being acquired under AIR9000 Phase 8) will be equipped with the Mk54 torpedo as a fully integrated component, without the capacity to operate the MU90. As noted in footnote 2, Defence is currently acquiring three new Hobart Class AWDs to progressively replace the FFG fleet between 2014 and 2019. The MU90 is being integrated onto the AWDs as a ship launched torpedo, although this is being managed by the AWD project.

resource implications of maintaining this mixed inventory of lightweight torpedoes.

17. The root causes of most of these issues go back to Defence's handling of this project in its early stages, which were highlighted in the previous audit (see paragraph 6 above). In particular, Defence's mistaken understanding in 1999 that the MU90 was already in service with other navies, rather than a developmental torpedo, led to a situation where risk was significantly under-estimated from the outset. The result was substantial schedule slippage and ongoing implications for test and evaluation.

18. When examining the project across its life and comparing it to the original plans, it is clear that it will not deliver the full capability originally expected. In addition to a six year delay in delivery of this capability, nearly the whole of the original budget that had been provided for integration of the MU90 with three air and two surface platforms will now be required to deliver capability to the two surface platforms only. This amounts to a significant real cost increase given the reduced scope. While it is not unusual for delivery of a complex defence capability to take several years, the MU90 reached the IOC milestone in November 2012, over 15 years after the need for a replacement lightweight torpedo for the Mk46 was identified in July 1997.

19. Technical demands have meant that original firing and sustainment cost estimates have grown considerably, even taking inflation into account. For instance, 1999 estimates of turnaround costs for a torpedo exercise firing were $16 000.[10] This grew to $419 000 in 2011, although recent estimates have reduced this to $317 000 as the exchange rate has improved and the estimated labour effort has reduced.

20. As discussed at paragraph 13, Defence and DMO are now close to completing the project and delivering a replacement lightweight torpedo capability, involving a reduced scope limited to Navy ships. In recent times, Defence has sought to avoid the potential costs and schedule risks associated with integrating the MU90 onto air platforms the ADF owns or is acquiring that already have a different lightweight torpedo integrated with them. Accordingly, going forward, the DMO will need to manage two very different inventories of lightweight torpedoes from different countries of origin. This

[10] Turnaround costs are the costs associated with refurbishing an exercise torpedo after firing in order to return it to inventory in its original state, ready to be used as warstock.

will place significant cost and personnel pressures on Defence and DMO for years to come, in an environment where budgetary pressures are increasing. Given these circumstances, the ANAO has recommended that Defence analyse and plan for the whole-of-life costs for operating and sustaining the mixed fleet of lightweight torpedoes.

Key findings

Project Management (Chapter 2)

A remediation plan was developed in 2011

21. Following the release of the previous audit in May 2010, broad remediation objectives for JP2070 were set out in monthly Project of Concern reports provided to Defence Portfolio Ministers (see paragraph 28). It took some time for a standalone remediation plan to be developed for the project. In the event, in September 2011 the Minister for Defence Materiel directed that a remediation plan be developed for the project. The focus of the plan was to be removal of JP2070 from the Projects of Concern list, the criterion for which was the achievement of IOC. A formal remediation plan was not finalised until November 2011. Following declaration of IOC by the Chief of Navy in November 2012, in December 2012 the minister agreed to DMO's recommendation that the project be removed from the Projects of Concern list.

22. The plan's objectives were statements about the milestones and events to be achieved in order to progress the project, and there was no detailed discussion of the key issues delaying progress or future risks. The plan was DMO-focused, as the majority of the remediation objectives specified in the plan related to the DMO milestone of Initial Materiel Release (IMR—achieved in January 2012).[11] Notwithstanding the findings of the previous audit regarding a lack of progress with OT&E, there was no mention in the remediation plan of OT&E (except that it requires simulation support), its risks or how these would be managed.

[11] IMR is a milestone that marks the completion of the delivery of products and services identified as the DMO's contribution to Initial Operational Release (IOR). IOR is the milestone at which the Capability Manager is satisfied that the initial state of the capability system, including any deficiencies, is such that it is sufficiently safe, fit for service and environmentally compliant to proceed into OT&E.

Intellectual Property access is limited

23. Intellectual Property (IP) emerged as a problem early on in the project, and the management and exercise of IP rights were identified as an ongoing issue at the conclusion of the previous ANAO audit in 2010. The Further Revised Alliance Agreement (FRAA) provides Defence with access rights to use and maintain the torpedo (to intermediate level) and support equipment in their current configuration.[12] However, access to background IP required for any modification or upgrade to the torpedo and support equipment (and required to gain full insight into the functionality and capability of the torpedo) is not provided.[13] This remains a potential source of risk given that two-thirds of the stock acquired under JP2070 is the MkI version of the MU90, and obsolescence issues have already been identified and addressed in the MkII version of the torpedo. Defence informed the ANAO in January 2013 that it does not foresee any requirement to negotiate expanded rights to manufacture, modify or enhance the weapon, as it is intended that this work will be undertaken within the international working group, which comprises nations that use the MU90.

24. Defence has obtained no ownership of foreground IP for development work undertaken under the FRAA,[14] specifically the development of the mobile Post Exercise Facility (see paragraph 59) and the torpedo trolley.[15] These were paid for by the Commonwealth and as such some of the IP would normally belong to the Commonwealth. However, the IP schedule to the FRAA shows that ownership of any new IP developed during the contract vests with the Industrial Participants or third parties. Defence does however have full access rights under the FRAA to the foreground IP.

Adequate personnel an ongoing challenge

25. Against the backdrop of a prolonged period of economic growth, DMO's ability to attract and retain an effective workforce has been

[12] Intermediate level maintenance involves warshot torpedo servicing every 3.5 years, and a major service involving a total strip-down and reassembly of each torpedo—including replacing some parts—every 10.5 years.

[13] Background IP is created independently of the contract (and may include any such IP owned by third parties that a party makes available for performing the contract).

[14] Foreground IP is developed in the course, and as a direct result, of carrying out the contract work. Access to foreground IP allows Defence to use the torpedo in its current configuration.

[15] A torpedo trolley has been developed to safely move the MU90 torpedoes from an FFG's weapons magazine to the torpedo tubes when at sea.

problematic. JP2070 has also struggled to obtain and retain sufficient skilled personnel since its inception. While there has been some general improvement in filling positions following the previous ANAO audit, the JP2070 project office has had difficulty attracting and retaining sufficiently skilled staff to fill Integrated Logistics Support and engineering positions. One consequence of this has been slow review of project documentation. In addition, shortages of skilled DMO personnel at the Torpedo Maintenance Facility in Western Australia led to additional contractor support being engaged from October 2011 to support MU90 torpedo production and maintenance.

Performance Monitoring and Reporting (Chapter 3)

Project reporting was adequate, except for Acquisition Overview Reports

26. Given that the previous audit identified problems with the reporting mechanisms used for JP2070, the ANAO examined the key Defence performance reports on JP2070 since early 2010: Acquisition Overview Reports, Project of Concern reporting, and bi-monthly reporting to Defence Portfolio Ministers on the progress of JP2070.

27. Acquisition Overview Reports were intended to provide a snapshot of project schedule, cost and capability performance, by using a traffic light reporting system to summarise projected performance. Overall, the material provided in the JP2070 Acquisition Overview Reports between 2010 and 2011 did not consistently provide an accurate and reliable picture of project performance, with multiple flaws noted. These included changes across months in the risk ratings allocated to the project that were not explained, inconsistencies within reports, and a lack of explanation and follow-up of some risks and events. In 2012 Acquisition Overview Reports were replaced by Acquisition Performance Reports, which are essentially an abbreviated version of the Acquisition Overview Reports and contain less narrative description.

28. A requirement of being listed as a Project of Concern is monthly reporting on the project to government. The JP2070 reports provided a more detailed picture of the project compared to the Acquisition Overview Reports, with greater narrative and context provided to explain traffic light ratings (albeit resulting in larger reports). The Acquisition Overview Reports and the Project of Concern reports would frequently provide a different picture of progress for the same period. Generally, the Project of Concern reports provided a more realistic and cautious appraisal of progress and risks than the Acquisition Overview Reports.

29. After the previous audit was released in May 2010, the then Minister for Defence introduced a requirement that Defence provide bi-monthly reporting to Defence Portfolio Ministers on the progress of JP2070. The bi-monthly submissions generally provided adequate advice on progress from an acquisition/DMO perspective, although there were instances where advice was incorrect, incomplete or could have been made clearer.

Two project reviews were undertaken

30. In July 2011, two retired Navy officers led a review of JP2070 project performance, including a comparison of the MU90 to other lightweight torpedoes. The review expressed high confidence in the project's ability to overcome remaining risks. However, it did not examine OT&E, which was a significant unknown at the time given that no agreed OT&E plan existed and developmental and acceptance testing was ongoing. The review noted that insufficient information existed on the Mk54 to make a comparison, yet concluded that the MU90 was the best solution for Navy's surface platforms. The review team was only given 11 days to undertake the review, and expressed concerns at the 'compressed timescales' for conducting such a critical and important review.

31. A Gate Review held for JP2070 in September 2011 recommended that the project should continue, with the required actions resulting from the review closed off by DMO in January 2012.[16] The review noted that access to foreign navies' data for validation of torpedo performance would 'significantly' reduce the number of OT&E firings required. However, there is no evidence that the review board was aware that there were significant limits to the information available on the performance of the MU90, and the need for waivers of many performance requirements.

Government releases funding in December 2011 to complete the project

32. In March 2008 and February 2009, the Government removed from the project's scope the three air platforms originally included. However, the total budget for JP2070 was not reduced. Instead, the funding originally dedicated to air platform integration that had not yet been spent ($111 million) was set

[16] Gate Reviews form part of DMO's internal assurance framework for major projects and are held at various stages of a project's lifecycle. They are intended to assist DMO in providing high quality and reliable advice to Defence and government on a project's health and outlook. For more information on Gate Reviews, see: ANAO Audit Report No.52 2011–12 *Gate Reviews for Defence Capital Acquisition Projects*, p. 13.

aside to assist in meeting any future cost increases in JP2070. In February 2009, the Government released $29.5 million from the $111 million to allow Defence and DMO to fund MU90 related work (such as the procurement of test equipment and spares, and engaging DSTO assistance), and to develop more robust estimates for accessing additional funding to allow project completion.

33. In December 2011 Defence sought, and the Government granted, a further allocation of $70.5 million (of the $72.7 million remaining) of the quarantined air integration funding in order to complete the project. This allocation was more than double that estimated in 2009 as being required, primarily because of increased cost estimates for OT&E, spare parts, and contractor support.

Torpedo Testing and Acceptance (Chapter 4)

The project continued to experience delays, but progressed into OT&E

34. At the conclusion of the previous audit, Defence aimed to achieve IOC in mid 2011 and FOC in mid 2013. In the event, this planned IOC timeframe was not met. IOC was achieved in November 2012, over one year late. Delays in achieving IOC occurred primarily because of technical problems encountered during acceptance testing and evaluation of ship integration, which were identified in November 2010 but largely resolved by mid 2011 (see paragraph 39). The IMR milestone was reached in January 2012 and the project formally transitioned to OT&E in May 2012, when Initial Operational Release (IOR) was approved by Chief of Navy. Declaration of IOR completed the MU90 capability transition from acceptance testing and evaluation to Navy OT&E, although some initial OT&E firings were conducted in March 2012 prior to the declaration of IOR.

35. The conduct of OT&E for the MU90 is expected to cost $17.5 million in total, and has to date involved :

- two deep water firings conducted in Western Australia in March 2012; and
- eight shallow water firings conducted in Northern Australia in September 2012, three of which encountered problems during their runs.[17]

[17] Another torpedo failed to launch, and this failure was caused by the umbilical cord connecting the weapon to the combat system being loose with salt contamination evident.

36. The Royal Australian Navy Test Evaluation and Acceptance Authority (RANTEAA)[18] highlighted in its advice to Chief of Navy that the final results from the 11 OT&E firings were:

- the shipborne surface lightweight torpedo system (which primarily incorporates the combat system and torpedo tubes—see Figure 1.3 for more detail) had a 91 per cent success rate in launching the MU90 torpedo;
- the MU90 torpedo had an 80 per cent success rate of operating correctly once launched; and
- the MU90 torpedo had an 88 per cent success rate at engaging the target when launched and operating correctly.

37. RANTEAA's final report on the OT&E firings (which formed the basis of the advice to the Chief of Navy) shows that, when measured from a whole of capability perspective (assessing all three criteria together), the overall MU90 lightweight torpedo system (both the MU90 torpedo and the shipborne surface lightweight torpedo system) had a 64 per cent probability of success. This is slightly below the probability requirement stated in the Detailed Operational Requirement (DOR) for JP2070, although this is defined as an important requirement rather that an essential requirement that must be met. Defence informed the ANAO that the probability requirement has been met as the torpedo that did not fire should be excluded, based on the fact that the testing was only concerned with in-water performance. The implication being that because the torpedo failed to fire and enter the water, it could therefore be excluded from the reliability calculation.

A ship integration solution has been developed, but some schedule risk remains

38. After the previous audit, problems continued with platform integration that culminated in failures during the November 2010 acceptance testing and evaluation firings. Since then, DMO has made good progress in addressing these problems, and the key integration issue is now completing final modifications to the entire ANZAC and FFG fleet by mid 2013. As at August 2012, half of both fleets (four ANZAC and two FFG ships) had received

[18] Navy's OT&E is managed by RANTEAA, whose mission is to provide the Chief of Navy with reliable and independent advice on new capability being offered for acceptance into the Navy and through OT&E define the operational capability.

their torpedo tube modifications, and the schedule for the remaining integration was assessed by DMO as 'extremely tight'.

The failures from the November 2010 firings were overcome

39. Acceptance test and evaluation firings during November 2010 encountered several problems. After undertaking analysis and identifying fixes, subsequent firings in mid 2011 were deemed as demonstrating the successful resolution of three of the four issues.[19] Problems with the remaining issue (the torpedo trolley) were largely resolved by mid 2012, although some minor trolley requirements need to be resolved before unconditional operational use can be granted. Development problems with the trolley have continued throughout the project, and the final cost to the Commonwealth of $218 000 per trolley is almost 10 times the original cost of $24 000 specified in the FRAA.

Defence decided on an Australian warshot firing

40. At the time of preparation of this report, there has been no warshot firing of an MU90 torpedo by any user nation. In August 2012, Defence agreed to fund the development and construction of a warshot target so that Navy can conduct an Australian warshot firing in the second quarter of 2013. Pursuing a local warshot firing represents a sound decision and aligns with Navy's doctrine. The decision also follows advice provided to the Government in December 2011, which stated that demonstrating complete effectiveness of the torpedo involves a test firing that includes detonation, given that this has not been done by any user nation.

The long term viability of the MU90 simulator is not certain

41. Simulation was recognised in the early stages of the project as critically important to reduce life-cycle costs and assist with OT&E. The previous audit noted that, while a number of options had been considered, limited progress towards the acquisition of a modelling and simulation tool had been achieved.

[19] These issues were:

- communication errors between the shipborne torpedo system and the torpedo, caused by umbilical cables that connect the two;
- gouging of the torpedo in the torpedo tube, caused by the tube's protruding temperature sensor; and
- the exercise torpedo's flotation device cover was lifting upon firing, caused by a build-up of pressure underneath the cover.

A failed attempt in 1999 to acquire a suitable simulator resulted in a 12 year hiatus and it was only in March 2011 that DMO and DSTO renewed efforts towards selecting a simulator. DSTO ultimately recommended that the WASS ORACOM simulator be procured, although neither of the two simulators considered in a request for tender fully met the simulator Function and Performance Specification.

42. The version of the simulator acquired for the MU90 is a stand-alone solution with no means to contribute to Defence's Federated (networked) simulation strategy. Defence is in effect also the first user of the MU90 ORACOM simulator, although the Italian navy has contracted the simulator supplier (WASS) to perform simulations using ORACOM. Further, as Defence has no background IP rights for the simulator, it cannot provide in-depth technical support by means of internal resources. In the circumstances, external support becomes critical, especially given the short lifetime cycles of computer hardware and software compared to the 30 year life of type of the MU90.

MU90 Weapon Performance (Chapter 5)

DMO had difficulty obtaining Objective Quality Evidence of weapon performance

43. Objective Quality Evidence (OQE) is qualitative or quantitative evidence relating to the performance of equipment, such as the MU90 torpedo or shipborne surface lightweight torpedo system, that Defence can use to form a judgement that a requirement has been met. This evidence may come from Defence's own analysis or testing, data provided by original equipment manufacturers (OEMs), or data provided by other users.

44. DMO has made good progress in verifying requirements relating to the Torpedo Maintenance Facility (TMF), the mobile exercise facility, and the surface lightweight torpedo system.

45. All requirements for the performance of the MU90 warshot torpedo itself required OQE in the form of Prior Qualification (PQ—where a requirement has already been proven, for example by Eurotorp or other users of the torpedo) based on factory acceptance testing. Less than one-third of warshot performance requirements had passed prior to OT&E firings in Northern Australia, with another third subject to waivers.

46. In an attempt to prove certain capability requirements, Defence decided to undertake some acceptance test and evaluation testing during OT&E, and rely heavily on the MU90 simulator. The root causes of this situation were the

mistaken belief at the time the MU90 was selected as the ADF's replacement lightweight torpedo that the torpedo was off-the-shelf, the subsequent failure to budget for additional testing when this was revealed to be incorrect, and the inability to obtain certain classified data about the torpedo's performance owned by the French Government.

47. As at February 2013, DMO expected that the results of OT&E, modelling and additional analysis would provide evidence to verify all but one of the outstanding requirements that had not been subject to waivers, however these findings were yet to be finalised. Waived requirements will not be verified, however DMO has collected evidence that goes part way towards demonstrating compliance with the waived requirements.

Range tracking remains problematic due to incompatibilities

48. The ADF's underwater ranges, which are used to track and record weapon performance during testing trials, cannot track the MU90 and this will not be rectified during the life of the MU90. Workarounds have been developed to track the torpedo, but these are not ideal, only enable torpedo location, and carry some risk, particularly for locating a weapon if it does not run to its programmed endpoint. To accurately reconstruct the torpedo's run path, Defence is largely reliant upon the torpedo's recording data.

Upgradability of MU90 in doubt

49. In August 2009 the Chief of Navy, on advice from DMO, opted to accept two-thirds of the torpedoes to be delivered under Phase 3 (warstock) in MkI configuration, rather than in MkII configuration. The MkII had been developed in response to an obsolescence review of the torpedo, with modifications made to core components of the torpedo. As the MkII had not yet been fully certified in August 2009, the Chief of Navy agreed to take more MkI torpedoes to minimise schedule risk. Ultimately, Defence received limited schedule benefit from accepting MkI torpedoes in lieu of MkII torpedoes under Phase 3, as the majority of Phase 3 torpedoes will be delivered later than specified in the April 2010 Materiel Acquisition Agreement schedule (which was signed after Chief of Navy's August 2009 decision).

50. While the MkI currently has the same capability as the MkII, there is no planned development path for the MkI. If future development occurs it will only apply to the MkII weapon. The MkI core software will not be further developed as it is incompatible with the MkII hardware. This means that the MkI will potentially become obsolete earlier than the MkII (if software development outstrips the MkI hardware limits).

There are gaps in Defence's understanding of its new lightweight torpedoes

51. In May 2011, the Government approved the acquisition of 24 MH-60R Seahawk *Romeo* helicopters under AIR9000 Phase 8. These maritime combat helicopters are equipped with, among other weapons, the US Mk54 lightweight torpedo (an evolution of the Mk46 torpedo). Defence and DMO will therefore have to manage two very different lightweight torpedo inventories for many years to come.

52. In 2009, DSTO performed a qualitative (desktop) analysis comparing the Mk54 to the MU90. The main Mk54 data used in that evaluation originated from a 2004 US test report, which contains the most up-to-date evidence Defence possesses on the Mk54. The DSTO report considered that the Mk54 and MU90 had broadly similar capabilities. Relying on this dated information presented a significant limitation in understanding the status of the Mk54.

53. In late 2011, DMO sought assistance, firstly from DSTO then from Capability Development Group (CDG), to undertake a study of the Mk54, including its viability, suitability, sustainment costs, and a 'side by side comparison of Mk46 [*versus*] Mk54 [*versus*] MU90'. This was to inform the then upcoming JP2070 submission to government. CDG considered that this task was a 'low priority' and not worth pursuing.

54. Given the lack of performance information on the Mk54, and the continuing gaps in Defence's understanding of the MU90, there is limited documented evidence to support Defence's advice to the Government at second pass for AIR9000 Phase 8 that the two torpedoes met the ADF's requirements and 'were considered comparable in capability'.

Sustainment of the MU90 (Chapter 6)

MU90 exercise firings are complex and expensive

55. Undertaking an exercise firing for an MU90 is a complex and expensive process, requiring coordination between multiple parties, both Defence and private contractors. After each exercise firing, the torpedo must be safely recovered, with the power source flushed and stabilised, before being transported back to the TMF for refurbishment.

56. The vessel used for MU90 OT&E recovery is significantly larger than the vessels able to be used for Mk46 firings, as the MU90 recovery vessel requires additional deck space to continue the torpedo flushing process for a further 16 hours, and requires a suitable crane to lift the torpedo aboard. The estimated cost to use this vessel for MU90 OT&E was $2.5 million.

57. Firing an MU90 exercise torpedo is considerably more involved and costly than for a Mk46 exercise torpedo for three main reasons:

- the use of a larger recovery vessel for the MU90;
- the cost to DMO per firing ($317 000 for the MU90 compared to $116 000 for the Mk46, with the difference due to additional labour and a more expensive refurbishment kit for the MU90); and
- the need for a portable exercise facility for MU90 firings outside of Western Australia.

58. The high cost and complexity of an MU90 exercise firing may well place pressure on Defence's capacity to meet its annual exercise firing requirements in the future.

Defence developed a mobile exercise facility for the MU90

59. Specialised facilities are required close to exercise and trial firing sites to refurbish the MU90 after each firing. For this reason, a dedicated mobile exercise facility (the Post Exercise Facility Mobile) has been developed by Defence and Thales for firings undertaken away from Western Australia (the TMF services the torpedo for firings in Western Australia). The mobile facility is made up of two shipping containers: one is a workshop and the other stores equipment, allowing maintainers to handle and work on up to three exercise torpedoes at one time using appropriate procedures and support equipment.[20] The facility was successfully used for the September 2012 OT&E firings in Northern Australia (the first time it had been used at capacity outside of Western Australia) and successfully supported the eight exercise firings in a three week period. This included supporting five exercise firings on one day, more than originally anticipated.

60. The mobile facility provides more flexibility than having a fixed facility on the Eastern Seaboard (which was the original intention). The need to build, maintain and transport the mobile facility, however, is a result of the unique and demanding maintenance requirements of the MU90 (especially the flushing requirements), and will impose an additional cost for future exercise firings outside of Western Australia.

[20] In order to fully operate, the facility requires a hardstand and access to water and electricity. To date, these have only been provided in Western Australia (Perth) and Northern Territory (Darwin). The necessary facilities have yet to be completed for the Eastern Seaboard.

Personnel and operating costs have not been fully developed

61. Separate from the cost of procuring military equipment (covered by a project's budget) are personnel and operating costs, which incorporate staff costs during a project's acquisition (not provided for under a project's budget), and the staff and equipment costs associated with the use of equipment over its life. Current MU90 estimates of personnel and operating costs are limited and have not been updated since 2008. Defence and DMO have recently gained a much more mature understanding of the torpedo, which will influence expected through-life costs. The ANAO has recommended (see page 33) that there would be benefit in Defence updating the estimated personnel and operating costs of the MU90 across its planned whole-of-life cycle.

Defence refines the cost of firing an MU90 exercise torpedo

62. As part of the July 2011 review of JP2070 (see paragraph 30), DMO developed a comparison of the cost to fire and maintain the ADF's current and future torpedoes (DMO costs only, excluding Navy and other costs such as torpedo recovery). The MU90 estimates were 700 hours and $419 000 per firing, which were more than triple the figures for the ADF's other lightweight torpedoes and were even greater than the ADF's heavyweight torpedo (the Mk48) (see Table 6.3 for detailed estimates). However, based on a more mature understanding of the labour costs and positive exchange rate impacts on the costs of required parts, by June 2012 the estimated turnaround cost for an MU90 exercise weapon had reduced from $419 000 to approximately $317 000.

63. Similarly, DMO's estimates as at August 2012 are that the cost to support one MU90 warshot torpedo as warstock inventory is almost double the cost for one Mk54 and is more than double the cost for one Mk46.

There are consequences of having a mixed inventory

64. Additional storage and personnel pressures will be placed on Defence because it will be supporting an inventory of three different lightweight torpedoes between late 2014 (when first deliveries of MH-60R helicopters and their Mk54 torpedoes are made) and up to mid 2021 (a possible retirement date for the AP-3C Orion, which uses the Mk46).

65. DMO is unable to fully leverage off its Mk46 staff, equipment and procedures with respect to the MU90 because of the different national origins and make-up of the torpedoes. The US International Traffic in Arms Regulations (ITAR) and IP restrictions require that the two torpedoes be stored and managed separately, with limited numbers of people having access to both

torpedoes.[21] In contrast, the Mk54 is an evolution of the Mk46 and will have a large degree of commonality in parts, equipment and procedures.

66. The need to sustain an inventory of three lightweight torpedoes will have personnel and sustainment cost impacts that Defence has yet to accurately assess. The ANAO has recommended that Defence analyse the full implications of operating its mixed inventory of lightweight torpedoes across their expected in-service life, so as to position itself appropriately to identify and manage the potential cost, technical workforce and facility implications.

Agency response

Defence welcomes the ANAO report on the *Remediation of Lightweight Torpedo Replacement Project*. Defence is committed to the continuous improvement of its project and contract management processes and recognises, and supports, the value of the recommendation suggested by the ANAO.

This is the second ANAO report on this project. Defence acknowledges that the Report provides an historical account of many of the challenges faced by the project from its inception, and identifies some weaknesses in aspects of Defence's management of alliance-style contracts, tendering arrangements and management of risk in complex projects.

Defence is pleased to note that following the initial ANAO audit, with appropriate allocation of resources, the project was able to make satisfactory progress towards Initial Operational Capability, which was achieved in November 2012. The project is on schedule to meet Final Operational Capability by mid 2013. The project has also been removed from the Government's Projects of Concern list and has been fielded for operational service.

The acquisition of a modem lightweight torpedo delivers an enhanced capability for Defence. The 2009 Defence White Paper stated the Government's intention to place greater emphasis on our capacity to detect and respond to submarines in the ADF's primary operational environment. The lightweight torpedo replacement project is an important element in this plan. This modern weapon has recently entered service, or is entering service, with five other navies and will provide a substantial improvement in the ADF's existing lightweight torpedo capability.

[21] ITAR are US regulations established under Section 38 of the US *Arms Export Control Act*, which control the export and import of defence articles and services. See: *ITAR Part 120 – Purpose and Definitions*, <http://pmddtc.state.gov/regulations_laws/itar_official.html> [accessed 10 October 2012].

Recommendations

Recommendation No.1

Paragraph 6.50

The ANAO recommends that, to inform its management of the ADF's lightweight torpedo capability and to inform future Defence budgets, Defence undertakes an appropriate analysis of the potential costs (including personnel and operating costs), technical workforce and facility implications of operating its mixed inventory of lightweight torpedoes across their planned whole-of-life cycles.

Defence's response: *Agreed*.

Audit Findings

1. Introduction

This chapter provides the background to the audit, an overview of the lightweight torpedo project and the findings of the previous ANAO audit. It also describes the scope and approach of this follow-on audit.

Background

1.1 Lightweight torpedoes are self-propelled, underwater projectiles that can be launched from ships and aircraft and are designed to home in and detonate on contact or in close proximity to a target. The Australian Defence Force's (ADF's) primary anti-submarine capability is provided by its maritime patrol aircraft, embarked helicopters and surface platforms.[22] The lightweight torpedo is the main anti-submarine weapon deployed on these platforms.

1.2 The process to acquire and introduce into service a new lightweight torpedo for the ADF commenced in 1997. In July 1997, Defence concluded that there was a need to acquire a new torpedo because the ADF's existing lightweight torpedo, the Mark 46 (Mk46), had major limitations and was not adequate for the ADF's needs.[23]

1.3 Given the significance of this capability to the ADF, the ANAO previously audited Defence's progress in acquiring and introducing into service a replacement lightweight torpedo—Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*. The key findings from that audit are set from paragraph 1.14. At the time that audit report was released in May 2010, substantial work was required to remediate the project and deliver the required capability. This audit examines Defence's progress in remediating the project and delivering the required capability to Navy.

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[22] 'Embarked helicopters' refer to naval combat helicopters that can be boarded on a surface platform. The ADF's surface platforms include eight ANZAC Class (FFH) and four Adelaide Class (FFG) ships. Defence are currently acquiring three Hobart Class Air Warfare Destroyers, which will replace the FFGs.

[23] The Mk46 torpedo, first deployed in 1965, is a surface ship and aircraft-launched anti-submarine weapon that has been acquired by more than 25 countries. Various modifications, including improved acoustics, guidance and control upgrades, and countermeasure-detection capability have been introduced into the weapon over time. The newer Mod 5A (SW) variant was introduced to the US fleet in September 1996, and contains improvements in counter-countermeasure performance and target acquisition, amongst other areas. The Australian Navy currently operates a mixture of older Mk46 Mod 1 and the newer Mod 5A (SW) variant, and can deploy the Mk46 from both surface and air platforms. Given commonality of components, there is also a cost effective upgrade path for the Mk46 to the new Mk54. For more information on the Mk46 torpedo see: Seaforces Online, 'Mk-46 Torpedo' <http://www.seaforces.org/wpnsys/SURFACE/Mk-46-torpedo.htm> [last accessed 15 November 2012].

JP2070: the project to acquire a new lightweight torpedo

1.4 In March 1998, Phase 1 of Joint Project 2070 Lightweight Anti-submarine Warfare Torpedo (JP2070) was approved by government to select and procure, through successive phases, a replacement lightweight torpedo and the associated support systems, and to integrate the torpedo onto the following ADF platforms:

- Adelaide Class Guided Missile Frigates (FFGs);
- ANZAC Class Frigates (ANZAC ships);
- AP-3C Orion Maritime Patrol Aircraft (Orion)[24];
- S-70B-2 Seahawk helicopters (Seahawk)[25]; and
- SH-2G(A) Super Seasprite helicopters (Super Seasprite).[26]

1.5 The Super Seasprite was removed from JP2070's scope in March 2008 when the Government decided to cancel that project. In February 2009, the Orion and the Seahawk were also removed from the project's scope because of technical and budget problems.

1.6 Accordingly, JP2070 currently involves integration of a replacement lightweight torpedo—the MU90—with only the two surface platforms included in the original project scope: eight ANZAC Class ships (see Figure 1.1) and four Adelaide Class ships (see Figure 1.2). The ANZAC Class ships are planned to be progressively withdrawn from service between 2025 and 2033, dependent upon a yet to be determined replacement future frigate.

1.7 The Adelaide Class fleet is planned to be progressively withdrawn between 2016 and 2019, depending on the delivery of three new Hobart Class Air Warfare Destroyers (AWDs). Defence is currently acquiring AWDs under

[24] The AP-3C Orion Maritime Patrol Aircraft is used by the Royal Australian Air Force for tasks such as naval fleet support, maritime surveillance, search and survivor supply and anti-surface and anti-submarine warfare.

[25] The S-70B-2 Seahawk is a twin-engine helicopter with features designed specifically for shipborne operations. The Royal Australian Navy operates 16 Seahawks. The Seahawks are due to be retired once the 24 MH-60R Seahawk Romeo helicopters are introduced under Project AIR9000 Phase 8, which is scheduled to reach Initial Operating Capability by 2015 and Final Operational Capability by 2023.

[26] Super Seasprite helicopters were to be acquired for the Navy for the purpose of enhancing the capability of the Navy's ANZAC Class ships, however the project to acquire Super Seasprites was cancelled in March 2008. The acquisition of 24 Seahawk Romeo helicopters under Project AIR9000 Phase 8 also replaces the cancelled Seasprite project. See Audit Report No.41 2008–09 *The Super Seasprite*.

Project SEA 4000 Phase 3[27], which is currently scheduled to achieve Initial Operational Capability (IOC) in March 2017.[28] The MU90 is being integrated with the AWDs as a ship launched torpedo, although this is being managed by the AWD project rather than by JP2070. The AWD will store a second lightweight torpedo—the Mk54—which will be used by its embarked helicopter, the MH-60R currently being acquired under the AIR9000 Phase 8 project.[29]

Figure 1.1

Frigate Helicopter (FFH) – ANZAC Class

Source: Defence photo.

[27] For more information on the AWD project, see ANAO Report No.20 2011–12 *2010–11 Major Projects Report*, pp. 185-195.

[28] IOC is defined as the point in time at which the first defined 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 achieved by the Capability Manager.

[29] The Mk54 is the next-generation Mk46. The Mk54 leverages torpedo technologies from the Mk50 and Mk48. It also utilizes the Mk46 warhead and propulsion subsystem.

Figure 1.2

Guided Missile Frigate (FFG) – Adelaide Class

Source: Defence photo.

1.8 The procurement approach adopted for JP2070 was the Defence Materiel Organisation's (DMO's) first attempt at conducting a major capital equipment acquisition using an alliance contracting model.[30] As a consequence of the acquisition being a prototype alliance, JP2070 carried additional project and contract management overheads in the establishment and initial management phases.[31]

1.9 As at January 2013, JP2070 had a total budget of $639 million, of which $523 million had been expended.[32] The project is divided into three phases:

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[30] According to the July 2011 *Defence Procurement Policy Manual*:

> Alliance contracting is a non-traditional contracting methodology that allows a high degree of flexibility in achieving project outcomes. Alliance contracts are characterised by 'no-dispute' clauses, except for specific events of default. The emphasis in alliance contracts is on building strong commercial relationships and aligning the interests of all participants so that the contract structure, including payment regime, motivates them to achieve a shared objective.

[31] The alliance for JP2070 is referred to as the Djimindi Alliance and comprises the Commonwealth of Australia, Thales Underwater Systems (as of July 2012, Thales Australia) and the Eurotorp European Economic Interest Group (GEIE). Eurotorp is a consortium formed in 1993 and comprises DCN International (a nationalised French company); Thales (a French company) and Whitehead Alenia Sistemi Subacquei (WASS) (an Italian company). The MU90 was developed by the Eurotorp consortium.

[32] The numbers do not add up due to rounding.

- *Phase 1* (complete), which focused on capability analysis, costing and solution selection. Phase 1 was completed in April 2001 at a cost of $5 million.
- *Phase 2* (ongoing), which involves the integration of the torpedo onto ADF platforms and the acquisition of a small number of torpedoes. Phase 2 has a budget of $335 million.
- *Phase 3* (ongoing), which primarily involves the acquisition of a torpedo warstock. Phase 3 has a budget of $300 million.

1.10 The project is currently being managed by the Guided Weapons Branch within the Explosive Ordnance Division of the DMO. The Explosive Ordnance Division was established in February 2008.

The torpedo

1.11 Defence is acquiring four versions of the MU90 torpedo: for combat, exercise and practice firings, and training:

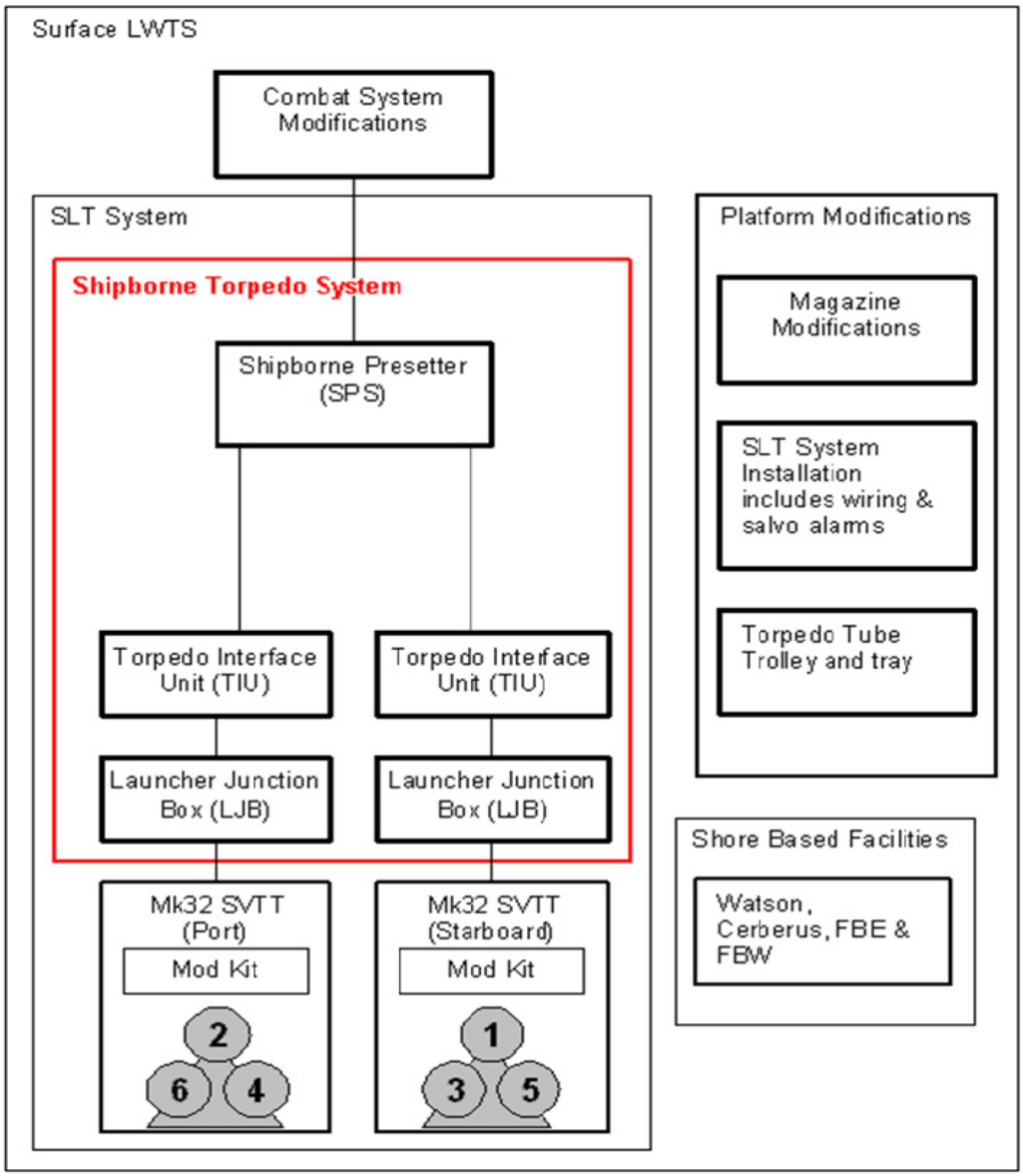
- Warshot MU90 Torpedo (TC)—the TC is the combat version of the MU90.
- Exercise MU90 Torpedo (TVE)—the TVE has the same mechanical and electrical interface and physical representation as the TC, but has an exercise section in lieu of a warhead. The TVE enables evaluation of the MU90's in-water performance.
- Practice Delivery Torpedo (PDT)—the PDT is carried and launched, but is not propelled. It comprises the same mechanical and electrical interfaces and physical representation as the exercise version. It will record preset data for analysis of 'weapon firing'. It allows lower-cost training for personnel.
- Dummy Torpedo (DT)—the DT can be carried and launched, but is not propelled. It has no recovery system and is not watertight. It has the same mechanical interfaces and physical representation as the MU90 TC. It allows crew training for handling and loading/unloading operations at minimal cost.

1.12 The replacement MU90 lightweight torpedo mission system comprises two primary elements:

- the MU90 lightweight torpedo; and
- the surface lightweight torpedo system (SLWTS) for each ship (see Figure 1.3).

Figure 1.3

Surface lightweight torpedo system



Source: Defence documentation.

Note on acronyms:

SLT = Ship Launched Torpedo.

SVTT = Surface Vessel Torpedo Tube.

FBE = Fleet Base East (HMAS Kuttabul, in Sydney).

FBW = Fleet Base West (HMAS Stirling, in Perth).

Key project events over time

1.13 Table 1.1 provides a chronology of key project events.

Table 1.1

Chronology of key project events

Date	Event
Jul 1997	Defence decided that the existing Mk46 lightweight torpedo should be replaced.
Feb 1998	JP2070 established to acquire a replacement lightweight torpedo.
Mar 1998	JP2070 Phase 1 (Project Definition Study) approved.
Oct 1999	Sole-source selection of Thomson Marconi Sonar's (now Thales Australia) proposal for the MU90 lightweight torpedo for the Phase 1 Project Definition Study.
Dec 1999	Defence decided to adopt an alliance contracting model for JP2070 Phase 1.
Apr 2000	Alliance Agreement for JP2070 Phase 1 (Project Definition Study) signed.
Apr 2001	The Project Definition Study report delivered and Phase 1 completed.
May 2001	JP2070 Phase 2 (integration and acquisition) approved by the Government.
Dec 2002	The Revised Alliance Agreement signed, combining Phases 1 and 2 of JP2070 into one agreement.
Nov 2003	JP2070 Phase 3 (acquisition of warstock) approved by the Government.
Aug 2004	DMO identified JP2070 as a project of concern.
Aug 2005	Further Revised Alliance Agreement (FRAA) contract signed, incorporating Phases 2 and 3.
Jul 2007	Acceptance of MU90 torpedoes purchased under Phase 2 completed.
Mar 2008	Super Seasprite helicopter removed from the scope of JP2070 when the project to acquire the helicopters was cancelled by the Government.
Jun 2008	First firing of an MU90 torpedo by an ANZAC Class ship.
Feb 2009	Government agrees to remove remaining two air platforms from the scope of Phase 2 and releases $29.5 million of air integration funding to cover other aspects of JP2070.
Nov 2009	First firing of an MU90 torpedo by an FFG.
Nov 2010	Failed acceptance testing firings from an ANZAC Class ship.
Aug 2011	Acceptance testing from an ANZAC Class frigate demonstrates resolution of key issues from Nov 2010 test failures.
Sept 2011	Gate Review conducted, which recommended that the project continue (see paragraph 3.25 for an overview of Gate Reviews).
Dec 2011	Cabinet releases a further $70.5 million of air integration funding to allow project completion.
Jan 2012	DMO claimed Initial Materiel Release (IMR) milestone.
Mar 2012	First set of OT&E firings conducted with 2 TVEs from an ANZAC Class frigate.

Date	Event
May 2012	Navy granted Initial Operational Release (IOR) milestone, completing the transition from acceptance to operational test and evaluation.
Sept 2012	Second set of OT&E firings conducted with 9 TVEs from an ANZAC Class frigate.
Nov 2012	Chief of Navy declares IOC for the MU90 lightweight torpedo mission system.

Source: ANAO analysis of Defence documentation.

Key findings from the previous ANAO audit

1.14 As indicated in paragraph 1.3, this is the second time that the ANAO has undertaken an audit of Defence's acquisition and introduction into service of the MU90 lightweight torpedo. The previous audit, released in May 2010, concluded that the acquisition of the replacement lightweight torpedo had not been managed effectively by DMO as the project: will not deliver the capability originally sought by the ADF; had not achieved schedule; and only remained within budget through a reduction in project scope. There had been significant weaknesses in Defence's risk management of the project and several key areas of risk emerged or gained increasing significance over the course of the project.[33]

1.15 The audit (p. 19) also concluded that:

> At the conclusion of the audit, the full cost of the approved phases of JP2070 could not be reliably identified as the JP2070 budget and scope was subject to further revision, with Defence intending to seek approval from the Government to release additional funding to complete integration of the weapon onto surface ships and undertake other activities. A range of important deliverables under Phases 2 and 3 are yet to be completed.[34] The timeframe for Navy achieving an operational capability has been defined in an April 2010 Materiel Acquisition Agreement, although transition into and out of Navy Operational Test and Evaluation continued to be an ongoing risk to JP2070.[35] This was 13 years after the Defence Capability Forum concluded that the existing lightweight torpedo [Mk46] needed to be replaced, 12 years after JP2070 commenced, and nine years after the Government approved Phase 2.

[33] See ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, May 2010.

[34] These included completing integration with the surface platforms, acquiring equipment for test and evaluation, conducting test and evaluation and torpedo delivery.

[35] In April 2010, Defence informed the ANAO in response to the previous audit that it aimed to achieve an Initial Operational Capability in mid 2011, with the torpedo to be fully in service with all equipment delivered in late 2013.

1.16 The following sections summarise key findings from the previous audit. Subsequent chapters of this audit elaborate on the findings where relevant.

Management arrangements

1.17 In April 1999, following consideration of four responses to a Request for Proposal, Defence decided to sole-source the Phase 1 Project Definition Study to Thomson Marconi Sonar, which was offering the MU90 lightweight torpedo.[36] By deciding to sole-source the Project Definition Study to the company offering the MU90 torpedo, the field for subsequent selection was limited to one type of torpedo. The main reasons advanced for this decision were the high level of Australian Industry Involvement being offered by the proponents of the MU90 and the perceived status of the torpedo as being fully developed and in service, in contrast to the developmental status of alternative torpedoes.

1.18 Between 2000 and 2004, JP2070 was subject to a number of internal reviews that identified failings in project management. However, Defence was successful in gaining the Government's agreement to bring forward approval for Phase 3 (the acquisition of warstock) from 2005–06 to November 2003, based on Defence's advice that in so doing there would be cost savings (which ultimately were not attained) and to improve the Alliance members' ability to meet Australian Industry Involvement targets.[37] An internal 2004 Red Team Review of the project expressed concern about DMO rushing into Phase 3 and not adequately finalising Phase 2 work and deliverables.[38] The primary basis for DMO committing to Phase 3 in August 2005, notwithstanding the known issues surrounding Phase 2, was that the Phase 2 contract (the Revised Alliance Agreement) placed the DMO in such a weak negotiating position that it was

[36] In September 2001, Thomson Marconi Sonar was renamed Thales Underwater Systems. Thales is a member of Eurotorp.

[37] In 2002, the Vice Chief of the Defence Force approved a proposal to bring forward government approval of Phase 3 'in order to realise further savings in the overall costs associated with the manufacturing component of the project.' On 26 November 2003, the Government subsequently approved Phase 3 at a cost of $246.43 million. The torpedoes acquired during this phase were to be 'assembled and part manufactured in Australia to meet Government [*Australian Industry Involvement*] Policy'. At the time the Government approved Phase 3, no torpedoes had been delivered under Phase 2.

[38] The purpose of a Red Team Review is to provide independent analysis of a projects in difficulty, especially with respect to project management, technical, schedule or cost difficulties. The Red Team Review for this project was instigated by the then Head Electronic Weapons Systems to assess the project's response to a number of action items raised during a Peer Review of JP2070 in September 2002.

the DMO's commercial assessment that it was necessary to use Defence's commitment to Phase 3 work as leverage to improve Defence's poor overall contractual position.

1.19 The contract, which included Phase 3 (the Further Revised Alliance Agreement—FRAA), was signed in August 2005, after Defence had become aware that the torpedo was in fact developmental, had technical problems, and before a series of test trials (the Technical and Industrial Action Plan—TIAP—program) established by the French and Italian Governments to confirm remediation activities was complete (see paragraph 1.24). The contract did allow the Commonwealth to amend or terminate the contract in the event the TIAP was not considered a success.[39]

Alliance contracting

1.20 Defence had not initially intended JP2070 use an alliance contracting arrangement: the decision to use this model was made after the decision to sole-source the Project Definition Study. The alliance arrangement implemented by DMO was not based on a structured analysis of contractual options and, once implemented, was not adequately supported. The alliance arrangement for this project generated additional risk to this acquisition, did not mitigate the risks it was intended to address, and shifted management focus away from project deliverables without demonstrating measureable benefits to project outcomes.

1.21 Recognising continuing problems with the project, Defence negotiated for the final agreed FRAA—signed in August 2005—to make more use of conventional contractual arrangements. However, the result was that significant risk with respect to platform integration (chiefly the three air platforms then within the project's scope) was transferred to the Commonwealth, as this work was removed from the contractual scope of work.

Cost

1.22 Defence's initial costing of Phase 2 was not sufficiently rigorous or subject to adequate scrutiny by Defence. The previous audit identified that the

[39] The contract stated that the TIAP trials would be successful when at least eight out of 10 firings were successfully completed in accordance with the TIAP requirements; or the French and/or Italian Government determined that the TIAP had been satisfactory.

project had remained within the original approved budget (as indexed) only by removing all three air platforms (in 2008 and 2009) from the scope of Phase 2. According to the August 2005 FRAA negotiation report, cost pressures were placed on JP2070 because Net Personnel and Operating Costs (NPOC) were not included in government budget approvals for Phase 2 or Phase 3.

Weapon development status

1.23 An inadequate understanding of the weapon and its development status between 1999 and 2004 contributed to an underestimation of project risk. During this time Defence and DMO believed the torpedo was an off-the-shelf acquisition that was already in-service with other navies; this was not the case. It was only in 2004, after the Government had approved Phase 3 of JP2070, that Defence formally acknowledged that the MU90 was not off-the-shelf and was still under development. Defence was not able to explain how it had reached the conclusion that the weapon was off-the-shelf and in service with other navies.

1.24 Following the poor performance of the MU90 during sea trials in 2004, the French and Italian governments established the Technical and Industrial Action Plan (TIAP) program, which was a series of test firings to confirm the success of remediation activities undertaken on the torpedo. The TIAP was to be completed by mid 2005, however the last firings occurred in October 2006. The TIAP was followed by an obsolescence review, which resulted in a new version of the torpedo (the MkII). In order to mitigate schedule risk, Defence agreed to accept a mixture of MU90s through phased delivery, obtaining both the older MkI (two-thirds) and newer MkII (one-third), rather than solely MkIIs as originally specified in the FRAA.

Integration

1.25 The risk involved in integrating the weapon onto multiple platforms (originally five—two sea and three air) was acknowledged but not fully appreciated at the outset of the project, and was compounded by a range of factors as the project progressed. The previous audit identified four broad categories of risk for JP2070 relating to platform integration: risk related to integrating onto platforms that were also subject to a number of other upgrades; planning assumptions for JP2070 being framed around unapproved projects; integrating onto a platform while other projects relating to that platform were encountering difficulties; and seeking to develop an Australianised integration solution for the Orion and the Seahawk. An

underestimation of the cost and technical risks for integration led to the removal of the Seahawk and Orion from the project scope in February 2009, while the Super Seasprite had been removed earlier when that failed project was cancelled in March 2008.

Testing and acceptance

1.26 At the time of the previous audit, the planning of testing and acceptance, and the resolution of testing and acceptance issues by DMO, was inadequate. In 2009, eight years after the Revised Alliance Agreement contract was signed for Phase 2, and two years after the initial batch of torpedoes procured under that Phase was accepted, DMO had yet to fully verify the capability acquired under Phase 2. The conduct of trials was delayed by issues related to both JP2070 and the FFG Upgrade Project.

Current audit approach

1.27 After the previous audit report tabled in Parliament, the then Minister for Defence, Senator Faulkner, stated that:

> The ANAO report clearly demonstrates that there have been - and remain - significant and serious problems associated with the development and procurement of the Lightweight Torpedo under Project JP 2070 …
>
> I frankly acknowledge that the management of this project and capability has simply not been good enough.[40]

1.28 Subsequently, the then Minister for Defence wrote to the Auditor-General in May 2010 requesting that the ANAO undertake a follow-up audit of JP2070 in another 12 to 18 months to provide independent assurance of the project's progress. The Auditor-General agreed to the Minister's request and scheduled this audit, which commenced in late 2011.

1.29 The objective of the audit was to assess the effectiveness of arrangements put in place by Defence and DMO to resolve issues impacting on the achievement of the desired lightweight torpedo capability. The scope of the audit covers progress made since the completion of the previous audit in improving the management of JP2070 and in delivery of the lightweight

[40] Senator the Hon John Faulkner, Minister for Defence, *ANAO Audit of Lightweight Torpedo Replacement Project*, Media Release MIN52/10, 20 May 2010.

torpedo capability as currently scoped, including the progress made with platform integration and test and evaluation.

1.30 In examining the effectiveness of project remediation since the previous audit, the following high-level criteria were used:

- remediation plans are appropriately documented, endorsed and followed;
- project progress is being effectively monitored, and key stakeholders are informed on progress, including the Government;
- platform integration has progressed according to plan;
- operational test and evaluation processes are ongoing, are based on validated plans, and there was a stakeholder endorsed transition from acceptance test and evaluation to operational test and evaluation; and
- an endorsed Initial Operational Capability was established as planned in mid 2011, with a clear path forward towards achieving delivery of the final operational capability as planned in 2013.

1.31 Audit fieldwork involved the interview of personnel, site visits and documentation collection from the groups listed in Table 1.2.

Table 1.2

Audit fieldwork conducted for the audit

Source	Location
DMO JP2070 project office, including Navy Guided Weapons System Program Office (GWSPO) and Explosives Ordnance Division (EOD) representatives	ACT
DMO Torpedo Maintenance Facility (TMF), including informal discussions with Eurotorp and Thales representatives	WA
Capability Development Group (CDG)	ACT
Royal Australian Navy Test Evaluation and Acceptance Authority (RANTEAA)	NSW
Head Navy Engineering	ACT
Navy Operational Regulation	NSW
Navy Integrated Logistics Support Certification	ACT
Defence Science and Technology Organisation (DSTO)	SA
DMO and CDG representatives for AIR 9000 Phase 8	ACT
Informal discussions with the Department of Finance and Deregulation (DOFD)	ACT

1.32 The audit was conducted in accordance with the ANAO Auditing Standards at a cost to the ANAO of $594 780.

Report structure

1.33 The remainder of the report is organised into five chapters:

- Chapter 2 examines key areas of JP2070 project management since the previous audit, including project remediation planning, contract and administrative management and project expenditure.
- Chapter 3 examines key Defence reporting on project progress and performance. It also discusses internal reviews of the project during 2011, and the approval by the Government of additional funding to allow completion of the project for the remaining two naval platforms in scope.
- Chapter 4 examines the progress Defence has made with testing and acceptance as well as integration of the MU90 with ADF platforms.
- Chapter 5 examines the extent of Defence's understanding of the MU90 torpedo's performance, concluding with a brief examination of Defence's view of the Mk54.
- Chapter 6 examines the process for MU90 exercise firings and the costs of firing and sustaining MU90 torpedoes, comparing these to other torpedoes in the ADF's inventory. This chapter also highlights the implications of supporting two very different lightweight torpedo systems (the MU90 and Mk54) into the future.

2. Project Management

This chapter examines key areas of JP2070 project management since the previous audit, including project remediation planning, intellectual property management and project expenditure.

Introduction

2.1 The previous audit of JP2070 examined Defence's management of this project over the period from its initiation in 1998 up until early 2010. This chapter examines Defence's progress since that audit in improving project management and managing the remediation of the project. The chapter also examines project risk management, and two specific areas of ongoing risk: intellectual property and human resources. The chapter concludes with an overview on project expenditure.

Planning for remediation of the project

2.2 Following the publication of the previous audit, the then Deputy CEO of DMO (DCEO) attended the May 2010 JP2070 Project Management Stakeholder Group (PMSG) meeting and briefed the group on his view of the project, his expectations going forward, and the need to have a plan for progressing the project. The minutes of the PMSG meeting record that:

> During the PMSG, DCEO emphasised the importance of using the word "plan" in addressing project issues as planning leads to a commitment from stakeholders and execution of the agreed plan. DCEO highlighted that a plan did not necessarily guarantee a successful outcome but it did ensure there was an agreed strategy that detailed responsibilities and recorded the justification for subsequent actions. DCEO reiterated that JP2070 could not falter in developing a plan that can be executed to achieve IOC [*Initial Operating Capability*].

2.3 The emphasis placed by the then DCEO on the importance of developing an agreed plan to support the effective remediation of the project is consistent with sound project management practice.

Development of remediation objectives

2.4 Remediation objectives for JP2070 were first developed and advised to Ministers through various monthly Project of Concern reports, commencing from May 2010 (these reports are discussed further in chapter 3).[41]

2.5 The remediation objectives set out in these first few Project of Concern reports from May 2010 were broad statements indicating the milestones required for achieving IOC. However, advice was not included on how Defence intended to resolve the specific outstanding issues impeding the achievement of these milestones. Later reports contained more detail on milestones, but were focused on the sequence of events required to reach the milestone rather than the actions required to resolve key issues delaying progress or future risks.

Development of a standalone remediation plan

2.6 In September 2011 the Minister for Defence Materiel directed Defence and the Djimindi Alliance Team to develop a remediation plan to progress JP2070 to a point where it could be considered for removal from the Projects of Concern list. The JP2070 remediation plan and its accompanying action log were finalised in November 2011.

2.7 The remediation plan states that the criterion for removal of JP2070 from the Projects of Concern list is the achievement of IOC, which the plan indicates was scheduled for November 2012. The plan lists 13 objectives, the deadlines for their achievement, and the actions associated with achieving the objectives. There is no detailed discussion of the key issues delaying progress or future risks.

2.8 The first action log describes the actions DMO and the major contractors had committed to complete within the six months September 2011 to the end of February 2012. The action items primarily relate to the torpedo trolley, torpedo simulator and torpedo tube modifications. A subsequent action log, covering the period April to October 2012, was developed in May 2012. Many of the issues covered differ from the previous action log, reflecting

[41] The Projects of Concern process is maintained by the Minister for Defence and the Minister for Defence Materiel as a means by which an increased focus on projects and industry is implemented in order to address project issues seen as significant by the Chief Executive Officer of DMO (CEO DMO) and the Government. Projects on the list of Projects of Concern are subject to additional scrutiny, with the aim of focusing attention on remediating schedule, cost, capability and/or project management issues.

the resolution of earlier issues and the project's progress into the Operational Test and Evaluation (OT&E) phase.

2.9 Overall, the remediation plan is DMO focused. There is no mention of OT&E (except that it requires simulation support), its risks and how these would be managed. The majority of the remediation objectives specified in the plan relate to the achievement of Initial Materiel Release (IMR), a precursor to IOC for which DMO is responsible.[42] However, the achievement of IOC requires more than the delivery of IMR by DMO—particularly the successful completion of initial OT&E.

2.10 Following declaration of IOC by the Chief of Navy in November 2012, in December 2012 the Minister for Defence and Minister for Defence Materiel agreed to DMO's recommendation that the project be removed from the Projects of Concern list.[43]

Project risk management

2.11 Until recently, key project risks were included in Materiel Acquisition Agreements (MAAs) for Defence projects.[44] The most recent iteration of the JP2070 MAAs—signed in August 2011—had all the project risks removed, even though they had yet to be resolved. This was a result of a change in the relevant DMO policy in June 2011, which stated that:

> For Major Projects, this table is only to be utilised for risks explicitly identified in the submission to Government and should only include those risks listed in the submission as high risk ...
>
> Post Approval, if a high risk is identified that may require the Project to be placed on a "best endeavours" basis, this would need to be addressed by the

[42] IMR is a milestone that marks the completion of the delivery of products and services identified as the DMO's contribution to Initial Operational Release (IOR). IOR is the milestone at which the Capability Manager is satisfied that the initial state of the capability system, including any deficiencies, is such that it is sufficiently safe, fit for service and environmentally compliant to proceed into OT&E.

[43] The project was on the Government's Projects of Concern list since 2008, when the list was first developed.

[44] An MAA is a formal agreement between Defence and DMO and is a key governance document for the management of major capability acquisition projects. In the case of JP2070 (which has separate MAAs for Phase 2 and Phase 3), the MAAs specify what DMO (as the supplier) will deliver to the Chief of Capability Development Group (representing Defence as the customer) and the Chief of Navy (the Capability Manager) for how much and when.

> Customer with the respective Government delegate. The Project would not be placed on such amended status without Government approval.[45]

2.12 Removing risks from the MAAs may potentially lower visibility and reduce ownership of the project risks. When asked about the removal of risks from MAAs generally, and specifically for JP2070, Defence informed the ANAO that Capability Managers and senior DMO managers rely on the project offices (based on their risk registers) and PMSGs to keep them informed of the emergence and management of risk. In particular, the Chief of Navy and the General Manager Systems in DMO informed the ANAO that these mechanisms were currently working effectively for them in the context of JP2070.

2.13 Going forward, Defence intends to articulate high-level risks within a project's Joint Project Directive.[46] However, in the case of JP2070, the high level risks to the project were removed from the MAAs without a Joint Project Directive in place.[47] Project risk registers and PMSGs represent appropriate methods to manage project level risks, which may change frequently. It is important that Defence develop Joint Project Directives in a timely manner, and that these Directives clearly articulate high-level risks to a project, which are less likely to change frequently.

Intellectual property

2.14 An important aspect of commercial contracting is the issue of intellectual property (IP) rights. As long ago as 1994, the Industry Commission commented on IP in its report *Defence Procurement*:

> The efficiency of acquisition of goods and services by Defence depends importantly on the ownership of and access to intellectual property (IP). This issue is becoming progressively more important as computer software accounts for a growing proportion of the procurement costs of many major projects. The ability to provide through-life support, and to extend the life of

[45] DMO Materiel Acquisition Agreement template, June 2011.

[46] Since February 2010, new projects achieving second-pass approval by government are also required to develop a Joint Project Directive. This document is the authoritative guidance to Project Directors in terms of what the project is required to deliver.

[47] Notwithstanding that JP2070 was a longstanding project as at February 2010, the Government required that Defence develop a Joint Project Directive for JP2070 as a requirement for receiving additional funding in December 2011. The Joint Project Directive for JP2070 has yet to be approved.

> many weapons 'platforms', depends critically on access to intellectual property.[48]

2.15 IP rights are central to most technology-rich projects, often requiring complex licensing and royalty agreements. The 2001 JP2070 Project Definition Study (conducted under Phase 1 of the project) indicated that IP access would not be an issue:

> the ability to maintain and upgrade software is fully confirmed and fully described in the [*Australian Industry Involvement*] AII plan.

2.16 However IP did emerge as a problem early in the project. In 2001, the Defence Science and Technology Organisation (DSTO) indicated that access to the software source code would be required to fulfil its role regarding improvements, analysis and evaluation of the weapon. A Defence internal audit report of June 2003 subsequently recommended that access be negotiated via government to government negotiations, as some of the necessary IP belonged to the French and Italian governments. A 2004 DMO Red Team Review also commented on this issue and warned that the lack of clarity over access to background IP was 'untenable'.[49] The previous ANAO audit noted that the management and exercise of IP rights continued to be an issue despite legal advice received by DMO that the FRAA improved the Commonwealth's position on IP issues.[50]

2.17 Defence has obtained no ownership of foreground IP for development work undertaken under the FRAA,[51] specifically the development of the mobile Post Exercise Facility (see paragraph 6.15) and the torpedo trolley.[52] These were paid for by the Commonwealth and as such some of the IP would normally belong to the Commonwealth. However, the IP schedule to the FRAA shows that ownership of any new IP developed during the contract

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48 Industry Commission, *Defence Procurement*, Report No.41, August 1994, p. 122.

49 Background IP is created independently of the contract (and may include any such IP owned by third parties that a party makes available for performing the contract). Access to background IP is required for any modification or upgrade to the torpedo. The FRAA does provide Defence with access rights to maintain the torpedo to intermediate level. Intermediate level maintenance involves warshot torpedo servicing every 3.5 years, and a major service involving a total strip-down and reassembly of each torpedo—including replacing some parts—every 10.5 years.

50 ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, pp. 104-108.

51 Foreground IP is developed in the course, and as a direct result, of carrying out the contract work. Access to foreground IP allows Defence to use the torpedo in its current configuration.

52 A torpedo trolley has been developed to safely move the MU90 torpedoes from an FFG's weapons magazine to the torpedo tubes when at sea.

vests with the Industrial Participants or third parties. Defence does however have full access rights under the FRAA to the foreground IP.

2.18 The terms and conditions of the FRAA mean that Defence does not have the right to independently analyse or modify the torpedo software and components—which requires access to background IP—and the Industrial Participants (Eurotorp and Thales Australia) have 'Right of First Refusal'[53] regarding any modifications. These arrangements are a potential source of risk given that two-thirds of the stock acquired under JP2070 are MkI torpedoes, and obsolescence issues have already been identified and addressed in the MkII version of the torpedo. Both the MkI and MkII torpedoes being acquired by Defence are not earmarked for any upgrading by the Original Equipment Manufacturer (OEM) (see also paragraph 5.42). Without access to relevant IP, should Defence wish in the future to upgrade the outdated components of the MkI version and extend its life of type, it will be obliged to contract with the OEM for this work. Further, without access to background IP, Defence will not be able to fully analyse or independently modify the MU90. Ultimately, Defence will also not have full insight into the functionality or capability of the torpedo as it is not privy to the software processing algorithms.

2.19 Defence informed the ANAO in September 2012 that:

> In buying a 'MOTS' [*military off-the-shelf*] weapon, Defence made a commercial decision regarding IP. It is important to note that the collaborative arrangements that Defence has on other weapon programmes, whilst providing better capability, come at a significant cost. There is a need to have the capability to modify the IP not just hold the IP itself. The costs associated with this are significant, especially in terms of FTE [*Full Time Equivalent staff*] and infrastructure: hence there is the usual trade-off between capability and cost.

2.20 While IP regimes for major capital acquisitions will vary across different contracts, there is no evidence that Defence undertook any cost-benefit analysis, or made any considered commercial decision, with respect to trading off IP access for cost. Additionally, the MU90 was not a 'military off-the-shelf' product at the time Defence selected the torpedo, despite Defence

[53] Right of First Refusal means that the Commonwealth must first offer the Industrial Participants the opportunity to perform additional work. However, the Industrial Participants are under no obligation to accept such work or to provide the Commonwealth with the background IP necessary for such work.

believing this to be the case: it was developmental, a key point highlighted in the previous ANAO audit and a more recent Senate Committee Report.[54]

2.21 Defence may also be limited in sharing information it gains about MU90 performance during joint Australian-US trials, as Defence is required to protect sensitive countermeasure information. Defence informed the ANAO in September 2012 that because the MU90 is now a NATO recognised weapon, the issues with use on US ranges might no longer be a problem.

2.22 Without full insight into the MU90 software, simulation work will largely be confined to tactical evaluation. In addition, without modification, the MU90 simulator cannot be incorporated into a Federated Model[55]—in contrast to the requirement in the JP2070 Simulation Operational Concept Document (simulation is examined further from paragraph 4.33).

2.23 The MU90 production and maintenance facility (the TMF) uses Eurotorp support equipment, including the Automatic Test Equipment for Torpedoes (UTAS). Defence has no access rights to background IP regarding the UTAS and will therefore be unable to enhance or modify the UTAS by itself.

2.24 A practice which can mitigate risk in relation to IP, where an OEM does not wish to contractually agree to provide Defence with direct access to it, involves having the relevant IP placed into escrow. With escrow, an agreed third party holds the IP in trust should the OEM cease operations, or the contract becomes subject to a major dispute. The FRAA does not require MU90 background IP to be placed into escrow. However, Defence's records indicate that Eurotorp, the marketing and contracting agent of the MU90, is set for dissolution in 2014.[56] Should this occur, further risks arise in relation to future access to IP.

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[54] Senate Foreign Affairs, Defence and Trade References Committee, *Procurement Procedures for Defence capital projects*, final report, August 2012, paragraph 2.60.

[55] A Federation of simulators exists where disparate simulators from all services are connected via networking to form a coherent, integrated and interacting simulation. The Defence Distributed Simulation Guide 2004 refers.

[56] Eurotorp is comprised of DCN International (a nationalised French company); Thales (a French company) and Whitehead Alenia Sistemi Subacquei (WASS) (an Italian company). The MU90 was developed by the Eurotorp consortium. Eurotorp itself does not manufacture anything, but serves as the marketing and sales arm of the original equipment manufacturers and the entity that liaises with buyers of the MU90. Purchasers of the MU90 have no direct dealings or agreements with the original equipment manufacturers.

2.25 In October 2012, in the course of the audit, Defence advised that DMO had initiated steps in negotiating a suitable IP deed regarding access to MU90 IP to cover through-life support, including placing certain critical technical information in escrow. As part of this process, DMO intended to conduct an IP needs analysis for the MU90. However, Defence informed the ANAO in January 2103 that Eurotorp has yet to provide an acceptable IP schedule suitable for analysis. The IP access arrangements Defence is now seeking to make, if achieved to the extent envisaged, should place Defence in a suitable position with regard to IP access negotiations. However, it is undesirable that such commercial negotiations take place so late in a project. Normally, it would be expected that matters as important as IP would be negotiated as part of the main contract, prior to signature, when the Commonwealth can expect to have more significant leverage.

2.26 Defence informed the ANAO in January 2013 that it does not foresee any requirement to negotiate expanded rights to manufacture, modify or enhance the weapon, as it is intended that this work will be undertaken within the international working group, which comprises nations that use the MU90. This means that access to background IP is therefore no longer required. Defence further informed the ANAO that:

> Defence does not need nor can it support access to modify the torpedo software as the IP access cost and infrastructure costs to do so would be prohibitive including the need to have complete hardware in the loop test facilities, software validation and verification and trained personnel in the event such [*a*] capability was needed.

2.27 Similarly, on the simulator, Defence advised;

> The Project Office, in consultation with DSTO, assessed that there was no requirement for the Commonwealth to modify the torpedo simulator source code - and the rights of 'use' with respect to the simulator provided by the selected ASDEFCON contracting template were sufficient and consistent with Defence's needs. The investment required of Defence to obtain such additional IP rights, reproduce the development environment, obtain the knowhow and capability to develop or enhance the simulator and certify it for use would be prohibitive, significantly increase program risk and not represent overall value for money. If Defence was to attempt to modify the simulator it would be difficult, with the impact of changes not being assessable in the short term, and very costly to verify and validate any changes and then certify the simulator for use once the source code is modified.

2.28 Given the central importance of IP in technology-rich capital equipment acquisitions, Defence should, as a matter of course in negotiating the acquisition contracts, seek to have any necessary IP placed in escrow if it cannot obtain, at a reasonable cost, outright access rights. With relevant IP in escrow from the outset, Defence would also be in a much better bargaining situation post contract signature should contractual difficulties arise, and would be less likely to be at a negotiation disadvantage.[57]

2.29 Defence is aware of these issues and informed the ANAO:

> If adequate IP and TD [*technical documentation*] rights, consistent with Defence's assessed whole of lifecycle needs, aren't secured at the commencement of the procurement cycle when Defence's commercial leverage is generally always greatest, Defence can find itself locked into a particular supplier for the maintenance, development, upgrade etc of the relevant equipment, and without any ability to undertake competitive processes to support value for money outcomes. There is certainly a risk that, post the acquisition stage of a project, the supplier will be unable or unwilling to provide the IP / TD needed for sustainment outcomes (eg where it wishes to preserve its monopoly status; where it no longer supports the relevant equipment; or has gone out of business - due to insolvency or some other reason).

2.30 Over the period since JP2070 was negotiated, Defence has sought to improve its policies on IP. Defence informed the ANAO in January 2013 that:

> The current Defence Intellectual Property (IP) policy and the current relevant strategic level ASDEFCON templates already provide for Defence to acquire the necessary IP ... and these are adequate in their current form.

Human resources

2.31 JP2070 has suffered from understaffing since its inception. While there has been some improvement in filling positions since the previous ANAO audit, the project has continued to suffer from high turnover and shortages of skilled personnel. At the time of fieldwork for this audit, both the JP2070 Project Office and the Torpedo Maintenance Facility (TMF) were experiencing

[57] The recent Senate Committee report on Defence procurement similarly noted that with the procurement of the MRH90 helicopter, DMO was aware of problems being caused by a lack of access to IP. Senate Foreign Affairs, Defence and Trade References Committee, *Procurement Procedures for Defence capital projects*, final report, August 2012, paragraph 2.47.

staffing issues.[58] This was reflected in an agenda item brief for the February 2012 PMSG meeting, which stated that:

> The project continues to suffer from the lack of specialised staff to carry out project activities in Integrated Logistic Support (ILS), Engineering, Djimindi Alliance Team (DAT) Engineering and Torpedo Maintenance Facility staff that has the potential to cause schedule delays. The project is actively recruiting staff with the required skill sets and Navy has provided additional personnel to assist while the positions are filled. The short term use of contract staff to cover the shortage of specialised staff has also been enacted.

2.32 Staff shortages have been a significant concern for the Project Director. One consequence of staff shortages has been inadequate review of project documentation. The agenda item brief for the February 2012 PMSG meeting stated that:

> There is a large volume of documentation provided by the OEMs [*Original Equipment Manufacturers*] as CDRL [*Capability Definition Requirement List*] Items during the life of the project that has not been reviewed by PO staff due to staff shortages, staff having heavy workloads. The implications will not be fully understood until further investigation is carried out by Project staff. The Project is commencing actions to review the outstanding documentation to overcome the large backlog of documentation with the current focus being on SG1s and priority correspondence.[59]

2.33 Shortages of trained DMO personnel at the TMF led DMO to obtain additional contractor MU90 support from October 2011. The additional contractor personnel are being used to address staff shortages in non-explosive production and maintenance, with DMO employees redirected to undertake the explosive production and maintenance work. Staffing deficiencies represent a high risk to the sustainment of all Navy guided weapons at the TMF.

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[58] Torpedo assembly and testing is performed at the TMF at HMAS Stirling, in Western Australia. The facility is manned by a combination of Commonwealth (mostly DMO) and contractor (mostly Thales) personnel.

[59] The Supplies Acceptance Certificate (Form SG1) provides for an authorised representative of the supplier to certify that the supplies conform in all respects to the conditions and requirements of the contract. Provision is also made for the supplier to record details of any non-compliance with the terms and conditions of the contract. Any non-compliance with contractual requirements must be approved by, or on behalf of, the Commonwealth Representative prior to acceptance.

Project expenditure

2.34 The successful delivery of major Defence projects requires the effective management and co-ordination of resources over an extended period. Two relevant sources of funding are a project's budget (to cover the cost of acquisition) and funding for personnel and operating costs (to cover the staff costs for a project, and the running costs of the purchased capability throughout its life). This section examines the JP2070 project budget, with personnel and operating costs examined in Chapter 6 in the context of sustaining MU90 torpedoes.

2.35 At the time of the last audit, the total JP2070 project budget was $666 million (January 2010 prices), split between Phase 1 ($5 million), Phase 2 ($347 million) and Phase 3 ($314 million). Of this total budget, $398 million had been expended (as at February 2010).[60] Table 2.1 summarises JP2070's current project budget, of which over three-quarters has been expended.

Table 2.1

JP2070 project expenditure as at January 2013 ($m)

Project phase	Original budget	Price & exchange movements	Current budget	Expenditure to date	Expenditure remaining
Phase 1 (complete)	4	1	5	5	0
Phase 2	288	48	335	256	79
Phase 3	246	53	300	262	38
Total	**$538m**	**$102m**	**$639m**	**$523m**	**$117m**

Source: Defence documentation.

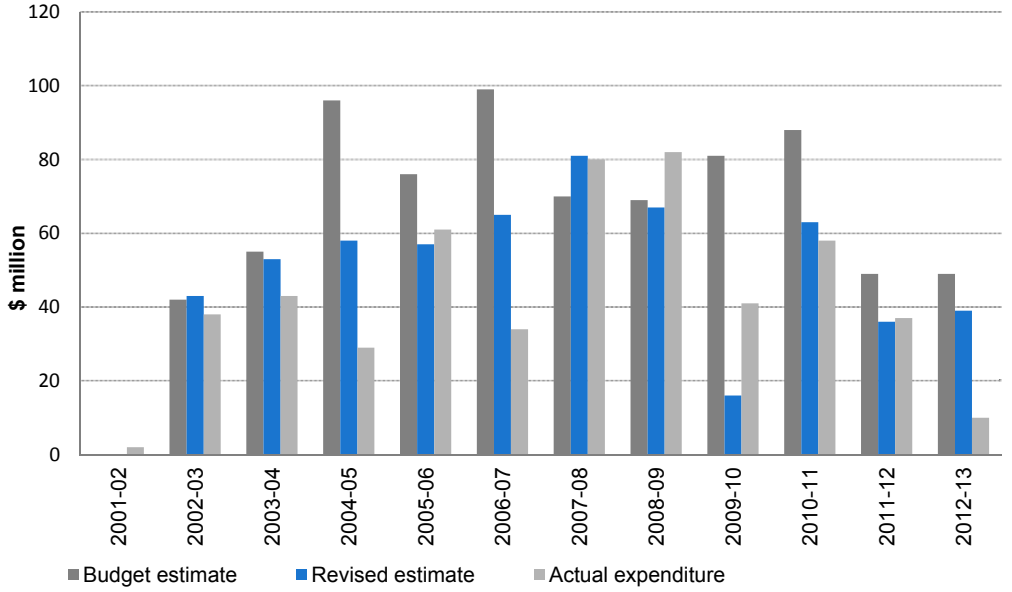
Note: Some numbers may not add up due to rounding.

2.36 Figure 2.1 illustrates the project's budget and expenditure over time. It shows that, in 2009–2010 and 2010–2011, expenditure was less than budgeted. This reflected the reduced quantity of work being undertaken under the project during this period, with work focused on ship integration and weapon quality issues, prior to receiving the Government's approval to access quarantined funds that were originally allocated to the integration of the MU90 with the three air platforms.

[60] ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, pp. 166–167.

Figure 2.1

JP2070 budgeted and actual expenditure over time as at January 2013



Source: ANAO analysis of Defence documentation.

2.37 In December 2011, the Government agreed to the reallocation of most of the quarantined air integration funding ($70.5 million of the $72.7 million remaining funding) to fund the completion of the reduced project scope. This amounted to a real cost increase for the remaining components of JP2070, as the funds were originally intended to cover integration of the MU90 with three air platforms as well as the two sea platforms remaining in scope (the ANZAC Class and the FFG).

Analysis of contract deliverables

2.38 In the course of examining several contract deliverables accepted by Defence against contractual requirements, the ANAO had concerns regarding value for money of the milestone payment made for one deliverable in particular—the 2008 update of the Australian Industry Involvement (AII) plan. This update cost $5.5 million, and the ANAO could identify little evidence of substantive change between the original version and updated version that would indicate the update represented value for money. As with the AII plan, several other contract milestone payments for deliverables of plans and similar

documents in the FRAA were also examined and these also appeared not to reflect the value of the deliverable.[61]

2.39 In response to this finding, Defence informed the ANAO in September 2012 that:

> One of the monetary principles agreed between Defence and the Industrial Participants in the development of the FRAA was for industry to maintain a neutral cash flow while ramping up production. This principle required milestone payments to be paid regularly which, during the initial period of Phase 3, required the identification of deliverables other than hardware against which payments could be made. This is also the reason that the Phase 3 milestones for the delivery of the final batches of torpedoes is a fraction of the actual cost of these items.
>
> While it is understood that the value of the earlier milestone payments did not necessarily reflect the value of the deliverable, there was a need to have a tangible delivery against which to measure progress and make payment. Delivery of management plans and the conduct of reviews provided a measurement of progress (management organisation in place, processes and procedures established, designs reviewed and approved etc) against which payment to maintain a neutral cash flow could be justified.

2.40 The kind of arrangement outlined above by Defence involves a form of prepayment, as the earlier milestone payments under the FRAA include an amount relating to later deliverables that is being paid early to support the ramping up of production. It is not uncommon for Defence to make a prepayment, in the form of a lump sum mobilisation payment amortised against milestones over the contract term. Commonwealth and Defence policy require that the relative value for money of making such prepayments should be taken into account in decision-making.[62] Such an analysis would identify whether the benefits of making such prepayments outweigh the financial

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[61] The costs of the Systems Engineering Management Plan, Quality Plan and Configuration Management Plan (with a combined cost of approximately $11 million); Integrated Baseline Review (approximately $6.6 million); and the Export Authorization (approximately $6 million) are all likely not to reflect the actual value of the deliverable.

[62] Under Part 7 of the *Financial Management and Accountability Act*, agency Chief Executives have 'special responsibilities' to manage agency affairs in a way that promotes the 'proper use' of public resources, which is defined as efficient, effective, economical and ethical use that is not inconsistent with the policies of the Commonwealth. Proper use includes making payments no earlier than necessary having regard to programme and service delivery objectives. As such, prepayments should only be made where the benefits to the Australian Government outweigh all costs, including all associated risks. See Department of Finance and Administration, Finance Circular No. 2004/14, *Discounts for prepayment and early payment*.

impact, primarily the opportunity costs to the Government of the advance payment.[63]

2.41 However, the arrangements for JP2070 under the FRAA are less transparent than such a mobilisation payment. The actual value of the early milestone payments under the FRAA is not clear, as the component of each payment that was paid early to support the ramp up of production, but actually related to later deliverables, is not separately identified. Equally, the later milestone payments, which involve less cost to Defence than the value of the relevant deliverables, do not separately identify the amount by which they are reduced in light of the earlier prepayments. In addition, Defence was unable to provide any contemporaneous cost-benefit analysis which informed the decision to incorporate these arrangements in the FRAA.

[63] Such as interest foregone, or public debt interest incurred, on the funds paid early.

3. Performance Monitoring and Reporting

This chapter examines key Defence reporting on project progress and performance. It also discusses internal reviews of the project during 2011, and the approval by the Government of additional funding to allow completion of the project for the remaining two naval platforms in scope.

Introduction

3.1 The previous ANAO audit identified that further enhancement of reporting and monitoring mechanisms for JP2070 was required to properly inform decision-making by both Defence and the Government.[64]

3.2 All Defence major capital acquisition projects involve some form of performance reporting to senior management. Reporting can range from status updates provided at defined intervals to more intensive reporting and review arrangements for particularly costly, sensitive or problematic projects. DMO provides regular performance reports to key stakeholders, including the Department of Defence, central agencies (such as the Department of Finance and Deregulation), and the Government.

3.3 Data from lower level internal DMO reports provide the basis for the higher level reports to senior DMO management, Defence and the Government. It is therefore important that information reported is consistent, accurate and timely. Citing the previous ANAO audit of JP2070 as an example, ANAO Report No.20 2011–12 *Major Projects Report* states:

> The ANAO also identified that, for some projects, there are issues with the accuracy and completeness of information in the current DMO systems for reporting on project status to senior management. This was highlighted in the case of reporting on Measures of Materiel Capability Performance [*for JP2070*], where indicators in the DMO's Monthly Reporting System did not always correspond with those presented in Acquisition Overview Reports (AORs) provided to the relevant Ministers.[65]

[64] ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, p. 20.

[65] ANAO Report No.20 2011–12 *2010–11 Major Projects Report*, p. 26.

3.4 Key Defence performance reporting on JP2070 since the previous audit has included:

- Acquisition Overview Reports (monthly reporting done by all DMO major projects, recently replaced by an abbreviated Acquisition Performance Report);
- monthly reporting as a requirement of being on the Projects of Concern list; and
- additional bi-monthly reporting to the Minister for Defence, which arose in response to the previous ANAO audit.

3.5 Given the reporting issues identified in the previous JP2070 audit, the following sections review the key project reporting mechanisms, to consider the quality of advice provided.[66] It also examines the advice provided to the Government in December 2011 to support Defence's request for the approval of funding to complete the project.

Acquisition Overview Reports

3.6 Acquisition Overview Reports (AORs) were intended to provide a snapshot of project schedule, cost and capability performance and used a traffic light reporting system to summarise projected performance. These were monthly reports prepared by DMO for the 30 highest valued projects, and provided to the Secretary and Chief of Defence Force Advisory Committee (SCAC), the Minister for Defence, the Department of the Prime Minister and Cabinet and the Department of Finance and Deregulation.

3.7 ANAO reviewed the JP2070 AORs produced in 2010 and 2011. Phases 2 and 3 of JP2070 were reported using separate AORs, and the AORs often had different monthly performance and ratings for each of the phases. Splitting reporting across the two phases (which is not done in Projects of Concern reports on JP2070) may make it more difficult for senior managers and the Government to gain an overall view of project performance and cost.

[66] Another reporting and governance mechanism—the Project Management Stakeholder Group (PMSG)—was also restructured after the previous audit was completed, meeting more frequently (approximately every six to eight weeks). Prior to this, meetings were generally held annually or bi-annually. The minutes of PMSG meetings for JP2070 form part of the ANAO's audit evidence.

3.8 Overall, the material provided in the reports did not consistently provide an accurate and reliable picture of project performance. A summary of deficiencies in JP2070 AORs identified by ANAO is provided in Table 3.1.

Table 3.1

Observations on JP2070 Acquisition Overview Reports, 2010 and 2011

Observation
Reporting frequently did not explain month-to-month changes in traffic light performance (for example ratings changing from red to amber or green, and vice-versa).
There were inconsistencies between traffic light reporting and narrative description/financial performance data.
Reporting was frequently marred by basic errors, such as the same traffic lights reported inconsistently within the same report, incorrect information provided (such as the balance of the contingency budget); and reports identifying errors within the narrative descriptions but not amending the summary information.
On occasions, no traffic light ratings were provided, resulting in missing trend information.
There was poor documentation/record control; for instance many reports were marked as draft, and some had no clearance sign-off date (these problems were also evident in Project of Concern reporting on JP2070—see paragraph 3.12).
While acknowledging that the brevity of the reports is part of the design, statements were made that did not provide the full picture, or explanations of events were not provided (two examples were discussion of a mobile target and the development of the torpedo trolley—see paragraph 4.28).
On occasion, risks or upcoming events would be raised in consecutive reports but would not be discussed in the subsequent report, giving no indication whether a risk was resolved or an upcoming event was achieved.

Source: ANAO analysis of JP2070 Acquisition Overview Reports.

New reports replace AORs

3.9 In November 2011, the Minister for Defence agreed to DMO's request to replace AORs and Sustainment Overview Reports (SORs) with new monthly reports—Acquisition Performance Reports (APRs) and Sustainment Performance Reports (SPRs). These reports are essentially an abbreviated version of the AORs and SORs, and contain less narrative description. The APRs produced for JP2070 in 2012 were generally adequate for their purpose, although a comment was made from the August 2012 report onward that 'no capability shortfalls are being forecasted'. This was first stated prior to the Northern Australia OT&E firings in September 2012, and continued to be made before the causes of the failed torpedoes were identified (see paragraph 4.18). More generally, DMO needs to consistently ensure that, where risks or

upcoming events are raised in consecutive reports, the outcomes of these are noted before the issue is removed from the reports.

Project of Concern reporting

3.10 The Projects of Concern process is maintained by the Minister for Defence and the Minister for Defence Materiel as a means by which an increased focus on projects and industry is implemented in order to address project issues seen as significant by the Chief Executive Officer of DMO (CEO DMO) and the Government. Projects nominated as Projects of Concern are subject to additional scrutiny, with the aim of focusing attention on remediating schedule, cost, capability and/or project management issues.

3.11 The ANAO reviewed the Project of Concern reports on JP2070 provided to Ministers from May 2010 to July 2012. These reports provide a more detailed picture of the project compared to the AORs, with greater narrative and context provided to explain traffic light ratings (albeit resulting in larger reports).

3.12 However, in common with the JP2070 AORs, there was poor documentation/record control associated with the Project of Concern reports, including: examples where there was no indication of sign-off by the relevant DMO senior executive; some reports were labelled as 'working notes'; and one report was labelled 'not cleared'. After receiving copies of these reports from DMO as part of the audit fieldwork, and given these and other record-keeping inconsistencies, the ANAO sought confirmation from the DMO Independent Project Performance Office (IPPO) on which reports had actually been submitted to Ministers. IPPO advised that one of the reports provided to the ANAO had not been submitted to the Minister, while an additional report was found that had been provided to the Minister but was not initially provided to the ANAO. Improved document management and record control would address these matters.

3.13 The ANAO observed that DMO was working to generally improve Projects of Concern reporting over the sample period (May 2010 to July 2012). For example, the format of the reports changed several times during this time, with the most recent iterations providing a clearer picture of project status and projected performance.

3.14 The JP2070 Project of Concern reports dating from May 2010 contained the first advice to Ministers on the initial remediation objectives for the project. As discussed in paragraph 2.6, DMO commenced developing a standalone

remediation plan for the project in September 2011, and this plan was finalised in November 2011.

3.15 A comparison of the AORs and Project of Concern reports for JP2070 over the sample period shows that, frequently, the two types of report provided a different picture of progress for the same period. The ANAO identified several instances where the Project of Concern report would highlight high risks to project performance and schedule, using red traffic light illustrations, while for the same period, the AORs would have either green or amber indicators for these. Defence informed the ANAO in September 2012 that the traffic light status in the Project of Concern and AOR reports are produced using different sets of data. Generally, the Project of Concern reports provided a more realistic and cautious appraisal of progress and risks than the AORs.

3.16 As noted in paragraph 2.10, following declaration of IOC by the Chief of Navy in November 2012, in December 2012 the minister agreed to DMO's recommendation that the project be removed from the Projects of Concern list.

Ministerial reporting

3.17 After the previous audit tabled in Parliament in May 2010, the then Minister for Defence introduced a requirement that Defence provide bi-monthly reporting to Defence Portfolio Ministers on the progress of JP2070. The ANAO reviewed the 10 bi-monthly submissions prepared for Ministers between the completion of the previous audit and September 2012.[67] The first such report was not provided to Ministers until January 2011. Since then, reports were generally delivered at two to three month intervals, with delays largely caused by the need to wait for updated information (such as the results of testing).

3.18 Defence advised Ministers that the delay of more than six months in delivering the first report was caused by the caretaker period ahead of the 2010 Federal election[68], the need to conduct analysis of failed November 2010 test firings, and the need to clarify part of the report and ensure a balanced

[67] There was also the December 2011 cabinet submission, discussed at paragraph 3.30.

[68] The caretaker period began when the House of Representatives was formally dissolved on 19 July 2010, and continued until the Governor-General swore in the Ministry on 14 September 2010. Defence informed the ANAO in September 2012 that ministers did not take submissions in the first few months of the new ministry.

viewpoint. The ANAO notes that a draft submission had been prepared in October 2010, signed off by the Deputy CEO DMO, however this did not proceed. Overall, the January 2011 update was a more detailed and realistic overview of the status and challenges facing JP2070 than the draft October 2010 submission.

3.19 Generally the bi-monthly submissions provided adequate advice on progress from an acquisition/DMO perspective, although there were some instances where advice was incorrect, incomplete or could have been made clearer. The most common issue identified by the ANAO related to cases where advice should have provided more context and clarification, which arose mainly around discussion of Australian Industry Involvement, test and evaluation, and the torpedo simulator.

Project reviews

3.20 Defence undertook two other reviews of JP2070 during 2011. These were a July 2011 review, led by two retired Navy officers and a September 2011 Gate Review.

July 2011 review

3.21 The two retired Navy officers who led the July 2011 review of JP2070 were tasked to make assessments of project performance.[69] As part of the review, they also undertook a comparison of the MU90 to other lightweight torpedoes. The review expressed high confidence in JP2070's progress and the project's ability to overcome remaining risks. However, the review did not examine OT&E (such as planning for, and risks to). This would have been a significant unknown at the time given that no agreed OT&E plan existed, and developmental and acceptance testing was ongoing.

3.22 The review team was given only 11 days to undertake a comprehensive project review, and the report expressed concern at the 'compressed timescales of the review'. Notwithstanding this limitation, the review was cited by both the September 2011 Gate Review and advice to government in December 2011 in support of continuing with the project as planned.

3.23 The review considered the only other lightweight torpedo alternative considered viable by Defence, the Mk54, and noted that:

[69] Both the officers were Naval Captains who were members of the Navy Reserve.

there is a paucity of technical and capability information within DMO, DSTO, CDG and Navy to make an assessment of viable alternatives.[70]

3.24 The review concluded that the MU90 was the best solution and there was too little information on the Mk54 to consider switching from the MU90. However, this definitive statement was based on limited and dated evidence relating to both the Mk54 and MU90 (the extent of Defence's understanding of the Mk54 is discussed from paragraph 5.45).

September 2011 Gate Review

3.25 Gate Reviews form part of DMO's internal assurance framework for major projects and are held at various stages of a project's life cycle. They are intended to assist DMO in providing high quality and reliable advice to Defence and the Government on a project's health and outlook.[71] In September 2011, a Gate Review of JP2070 was held to consider whether the project should continue.

3.26 The Gate Review Assurance Board recommended that JP2070 proceed, and developed a list of action items requiring attention prior to the end of 2011. DMO considered that the items had largely been completed by January 2012. In reaching its view, the Gate Review Assurance Board noted advice from Navy that the MU90 is the best available solution for its surface platforms, a view also formed by the July 2011 review. The Gate Review also noted that validation of torpedo performance was being met through Eurotorp data; data from other navies; and Australian test data. Access to other navies' data was cited as reducing 'significantly' the number of test launches required to complete OT&E. However, the Gate Review Outcomes document did not indicate the extent to which the board gave consideration to the limitations in available information on the performance of the MU90 and the need for waivers of multiple performance requirements (see Chapter 5).

3.27 The September 2011 Gate Review commented on the 'reduction in the overall level of risk of the Project' but noted:

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[70] In June 2011, the Government decided that the ADF would acquire 24 new Sikorsky-Lockheed Martin MH-60R maritime helicopters (known as the Romeo). These helicopters come equipped with, amongst other weapons, Mk54 torpedoes. The Mk54 is the next-generation of the Mk46. The Mk54 leverages torpedo technologies from the Mk50 and Mk48. It also utilises the Mk46 warhead and propulsion subsystem.

[71] For more information on Gate Reviews, see: ANAO Audit Report No.52 2011–12 *Gate Reviews for Defence Capital Acquisition Projects*, p. 13.

> The inconsistency in the descriptions of Project risk between the documentation provided to the Board and the current Project of Concern brief, with the Board assessing that the [*Project of Concern*] brief did not provide an accurate assessment of the Project risk (ie, the Board considered that the risk was lower).

3.28 Up until February 2012, the JP2070 Project of Concern reports listed the project as high risk, and did not recommend removing the project from the Projects of Concern list as:

> The risk profile of this project remains high across all categories.

3.29 The February 2012 Project of Concern report was the first to significantly reduce the assessed risk of JP2070 across commercial, technical, schedule and cost parameters. However, it continued to recommend that the project not be removed from the Project of Concern list. By July 2012, the report listed only schedule (medium) and reputation (high) as parameters with greater than low risk.

Government approval of funding to complete the project

3.30 The scope of JP2070 was reduced in March 2008 following the cancellation of the project to acquire the Super Seasprite, and again in February 2009 when the Government approved removal of the remaining two air platforms from the project's scope (the Seahawk and the Orion). However, the total budget for JP2070 was not reduced. Rather, the Government decided that the air integration funding would be set aside to help fund future cost increases for the rest of the project, subject to further approval. This air integration funding had previously been 'quarantined' by the Minister for Defence in 2005, meaning that ministerial approval was needed to access this funding.

3.31 In February 2009, the Government decided on a two-stage approach for Defence to access this funding. The first stage involved the immediate release of $29.5 million, while the remainder of the air integration funding ($72.7 million) was to remain quarantined until better cost estimates were available. Defence informed the ANAO that the need to use this additional funding to complete the reduced project scope arose from the mistaken assumption at the start of the project that the torpedo was in-service, and an underdeveloped understanding of the costs to integrate the torpedo with the relevant ADF platforms and introduce the torpedo into service.

3.32 Based on the outcomes of the September 2011 Gate Review and the July 2011 review, Defence sought funding from the Government in December 2011 to complete the project. The Government approved the use of $70.5 million of the $72.7 million preserved funding, with the remaining $2.2 million returned to the Defence Capability Plan (MYEFO 2011–12 out-turned price and exchange rate). The Government was advised that the overall risk rating for JP2070 Phase 2 was now assessed as medium, with the outcomes of the July 2011 review and the Gate Review cited as evidence of project improvement.

3.33 The December 2011 submission to the Government acknowledged that the torpedo was not mature when selected. However, it noted that 'a number of significant technical challenges… had been largely fixed by 2007'. In the submission Defence provided the Government with the following assessment of the MU90 torpedo:

> The MU90 has been assessed as the most effective and lethal lightweight torpedo currently in production. It has been designed for good shallow water performance, which is critical in our region, and to overcome countermeasures that might be employed by targets. This capability can be upgraded in response to changing threats by upgrading software ...
>
> There have been no developments since the 2009 [*Government*] consideration that reduce the need to acquire the new lightweight torpedo capability.

3.34 Notwithstanding Defence's December 2011 advice to the Government, the ANAO notes that:

- performance in shallow warm water and against countermeasures were two areas where the performance of the MU90 was unknown at the time, and was a key driver for Defence's decision to undertake OT&E firings in Northern Australia in September 2012[72];
- software upgrades are not currently planned, and are likely to be limited to the MkII version, which makes up less than one-third of Australia's MU90 inventory (see from paragraph 5.37); and
- the basis of the assessment that 'the MU90 has been assessed as the most effective and lethal lightweight torpedo currently in production' is unclear. There have been no contemporary and objective comparisons between the MU90 and other lightweight torpedoes such

[72] See paragraph 4.18 for more detail on the September 2012 OT&E firings.

as the American Mk54 and British Stingray Mod1. DSTO and Capability Development Group acknowledged in late 2011 that Defence does not hold complete and verified performance data for the MU90 or the Mk54 (see paragraphs 5.50 and 5.51). Further, Defence did not receive the MU90 simulator until May 2012 (see from paragraph 4.33 for more information regarding the simulator).

4. Torpedo Testing and Acceptance

This chapter examines the progress Defence has made with testing and acceptance, including simulation, as well as integration of the MU90 with ADF platforms.

Introduction

4.1 Delivering capability into service can be a large-scale and complex undertaking requiring close management of project planning, acquisition and acceptance. It requires all parties to have a clear understanding of the requirements and risks, with clear procedures to verify and validate the achievement of those requirements. This helps avoid situations where the transition from acquisition to in-service becomes a 'voyage of discovery' during the final stages of test and evaluation.[73]

4.2 The previous chapters focused on project management, monitoring and reporting as part of the acquisition phase. This chapter looks at the status of test and evaluation (including the key role of simulation), transitioning from the acquisition phase (acceptance testing and evaluation) to the in-service phase (operational testing and evaluation).

Status at the conclusion of the previous ANAO audit

4.3 The key findings of the previous audit in relation to testing and acceptance are summarised in Table 4.1. Some of the limitations and issues encountered were the direct result of poor management of the initial phases of this project. In particular, the failure to make adequate inquiries to establish the actual development status of the MU90 before sole-sourcing the Project Definition Study in 1999 (which removed competition to the MU90), and before the MU90 solution was approved by Government in 2001, resulted in Defence proceeding on the basis that it considered the MU90 to be an off-the-shelf procurement. This meant that the developmental risk associated with the torpedo was not appreciated or appropriately treated. The previous audit made a recommendation on the need to obtain sufficient evidence to verify

[73] ANAO Audit Report No.57 2010–11 *Acceptance into Service of Navy Capability*, pp. 14, 25.

claims that an item is 'off-the-shelf', and another recommendation on addressing the risks associated with projects modifying numerous platforms.[74]

Table 4.1

Key findings from the previous ANAO audit: testing and acceptance

Topic	Key Findings
Status of torpedo	The Phase 1 Project Definition Study failed to determine that the MU90 was a developmental weapon. This led to an acquisition program and planned test and evaluation program unsuited to a developmental weapon.
Platform integration	The risk of integration was transferred to DMO with the signing of the FRAA in 2005. A series of integration risks impacted on the project, including: • the platforms were subject to other upgrades at the same time; • related platform projects were experiencing difficulties; • planning was framed around unapproved projects; and • seeking an Australianised solution for the Orion and Seahawk. By February 2009, the number of platforms to be fitted with the MU90 under the project was reduced from five to two.
Test & evaluation	Australian testing was still ongoing at the conclusion of the audit, with trials encountering problems and yet to confirm compliance. Test and evaluation documentation was developed late, and planning was still ongoing. There were significant limitations accessing Objective Quality Evidence (OQE). Procuring a suitable OT&E target was unresolved. Procuring a suitable modelling and simulation capability was unresolved.
MkII	An obsolescence review resulted in the redesign of the MU90 to produce the MkII. In 2009, Defence decided to procure a mixed fleet of torpedoes, primarily MkIs, in order to reduce Phase 3 schedule risk.

Source: Summarised from ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*.

4.4 At the conclusion of the previous audit, the test and evaluation necessary for operational release of the torpedo and the shipborne lightweight torpedo system continued to represent an ongoing risk. Defence's response to the audit stated that it aimed to achieve Initial Operational Capability (IOC) in mid 2011, with the torpedo to be fully in-service with all equipment delivered in late 2013. At that time, the project was considered to be in transition from

[74] Recommendations Nos. 2 and 3 of the previous report. See Appendix 1 for a complete list of the recommendations in the previous report.

acceptance testing and evaluation (AT&E) to operational testing and evaluation (OT&E).[75]

Progress since the previous ANAO audit

4.5 The planned IOC timeframe of mid 2011 mentioned at paragraph 4.4 was not met. IOC was achieved in November 2012, over one year late. This additional delay chiefly occurred because of technical problems that arose during acceptance testing and evaluation of ship integration (see paragraph 4.11). The current planned Final Operational Capability (FOC) date is June 2013.

4.6 In January 2012, the Head of DMO's Explosive Ordnance Division informed Chief of Navy that DMO had met the Initial Materiel Release (IMR) milestone and completed AT&E, although some torpedo performance requirements were to be tested during OT&E (this is discussed in detail in Chapter 5). In May 2012, the Chief of Navy approved Initial Operational Release (IOR) of the MU90 lightweight torpedo capability for *HMAS Newcastle* (Adelaide Class—FFG) and *HMAS Warramunga* (ANZAC Class—FFH). The declaration of IOR completed the MU90 capability transition from acceptance test and evaluation to Navy OT&E.

4.7 The rest of this section discusses the key issues and events relating to the progress of torpedo testing and acceptance in the period between the previous audit and the declaration of IOC in November 2012.

[75] According to Defence Instruction (General) OPS 43–1 *Defence test and evaluation policy*:

> The purpose of T&E in Defence is to obtain information to support the objective assessment of a capability system with known confidence. Results of T&E are fundamental for decision making when validating operational concepts and end-user requirements, evaluating designs or modifications, identifying alternative designs, comparing and analysing trade-offs when capability specifications cannot be met, verifying contract compliance, and evaluating system performance.

Defence has three categories of test and evaluation:

- developmental (DT&E), undertaken to demonstrate compliance with design specifications;
- acceptance (AT&E), undertaken to demonstrate that materiel meets contractual requirements and specifications; and
- operational (OT&E), undertaken to demonstrate the operational effectiveness and suitability of the capability to fulfil its intended role.

Ship integration status

4.8 After the previous audit, problems continued with platform integration, leading to further delays. These culminated in failures during the November 2010 AT&E firings (discussed below). Since then, DMO has made good progress in addressing these problems, and the key integration challenge now relates to completing the final modifications to the entire ANZAC and FFG fleets.

4.9 As at August 2012, half of both fleets (four ANZAC ships and two FFG ships) had received their torpedo tube modifications, with the remainder due to be completed during regular docking cycles. These modifications are due to be completed by mid 2013. In addition to modifying the torpedo tubes, the completion of ship integration requires a series of stowage, procedural and training issues to be resolved, together with the delivery of all torpedo trolleys for the FFGs (see paragraph 4.28). These remaining tasks are also scheduled to be completed by mid 2013. As at August 2012, DMO considered the overall schedule as 'extremely tight'.

Test and evaluation firings during the AT&E phase

4.10 Table 4.2 shows the extent of the test and evaluation firings of the MU90 during the AT&E phase, highlighting that there were only four TVE firings as part of AT&E. Two of these TVE firings failed outright and the others involved controlled testing. DMO's focus during AT&E was on platform integration and modifications to the torpedo, not the in-water performance of the torpedo (discussed in Chapter 5).

Table 4.2

MU90 firings during AT&E

Date	Platform	Description
Developmental Test and Evaluation (DT&E) and Acceptance Test and Evaluation (AT&E)		
June 2008	*HMAS Toowoomba* (ANZAC)	AT&E of six PDTs[(A)] and one TVE. Tested integration of torpedo and limited in-water performance. Considered a success, but Critical Operational Issues subsequently changed to reflect operational requirements.
November 2009	*HMAS Anzac* (ANZAC) *HMAS Darwin* (FFG)	AT&E of six PDTs and two TVEs. Tested integration of torpedo on both ship classes (although at a lower level of integration on the FFG). PDTs launched, but problems with ship torpedo systems identified. One of two TVEs failed to start.
November 2010	*HMAS Warramunga* (ANZAC)	AT&E. Firings of two PDTs and one TVE were unsuccessful. Problems included cable failures creating communication errors, lifting of flotation device cover, scratching of torpedo when inside tube.
June & August 2011	Wharf-mounted torpedo tubes	DT&E. 34 PDTs launched, 10 to test replacement cables and modifications to torpedo tubes, and 24 to test modifications to covers. Issues resolved.
August 2011	*HMAS Warramunga* (ANZAC)	AT&E of six PDTs. Demonstrated successful resolution of most problems from November 2010 firings, with outstanding issues resolved at a later date.

Source: ANAO analysis of Defence documentation.

Note A: The practice MU90 torpedo (PDT) is launched but not propelled, and is used to test weapon firing (see paragraph 1.11).

November 2010 firings

4.11 A major DMO focus since the last audit was on resolving problems encountered during the November 2010 AT&E firings in the Western Australia Exercise Area (WAXA), which had led to delays in the project. Key problems encountered were:

- communication errors between the shipborne torpedo system and the torpedo, caused by umbilical cables that connect the two;
- gouging of the torpedo in the torpedo tube, caused by the tube's protruding temperature sensor;

- the exercise torpedo's flotation device cover was lifting upon firing, caused by a build-up of pressure underneath the cover; and
- the continuing delay in developing a robust torpedo trolley.

Figure 4.1

Practice torpedo (PDT) firing from *HMAS Warramunga*, November 2010

Source: Defence photo.

4.12 Further firings in June and August 2011 were undertaken to test modifications to the tubes, cables and covers (discussed in the box below). The results of these firings, and subsequent *HMAS Warramunga* firings, were deemed as successfully resolving these three issues. Their resolution was critical in allowing ship integration to proceed. However, problems with the torpedo trolley were not resolved at that time.

4.13 Modifications to the torpedo cover were subject to verification by DSTO, which occurred in December 2011. DSTO reviewed a report provided by the torpedo manufacturer (WASS) on the results of a numerical analysis (simulation) of the modified cover. The review supported the basic conclusion that the cover redesign appeared successful, although it did raise concerns that the simulation might have been limited.

Case Study

June and August 2011 DT&E highlight successes in addressing deficiencies

To test DMO's proposed solutions to failures from the November 2010 firings, a series of DT&E firings were conducted at Garden Island in Sydney in June and August 2011. These firings used a wharf-mounted surface vessel torpedo tube (SVTT) (see Figure 4.2) that had been modified to rectify torpedo interface issues. A PDT torpedo (modified so that the flotation collar did not deploy, allowing multiple firings of the same torpedo) was launched from the SVTT and into a DSTO-developed recovery device, which allowed retrieval of the PDT without a ship. The set-up was supported by the use of a high speed camera, to record any damage or lifting of the torpedo covers.

The initial June firings demonstrated that the modified SVTT, including the use of new umbilical cables, was now suitable to use on board firing ships. There were, however, continuing problems with cover plates lifting off the torpedo (the cover plates conceal the torpedo's flotation device). Later wharf-based DT&E in August 2011 involved over 30 PDT firings and successfully tested a cover, which had been modified by Eurotorp using the June 2011 firing data.

The results were then validated by the August 2011 firings from *HMAS Warramunga*, which utilised the modified SVTT and PDT cover. Undertaking these wharf-based firings was a cost-effective and practical approach to addressing deficiencies uncovered in the November 2010 firings.

Figure 4.2

Wharf-based torpedo testing, June 2011

Source: Defence photo.

Progression from acceptance to operational testing and declaration of IOC

4.14 Central to progressing a capability to final acceptance is Navy's OT&E. OT&E is conducted with representative users of the system, in the expected operational context, for the purpose of determining a system's operational effectiveness and suitability. Navy's OT&E is managed by the Royal Australian Navy Test Evaluation and Acceptance Authority (RANTEAA), whose mission is to:

> provide Chief of Navy with reliable and independent advice on new capability being offered for acceptance into the Navy and through OT&E define the operational capability.

4.15 The MU90 OT&E plan, which had been in draft form since 2009, was finalised in February 2012. The plan outlines the types of testing to be undertaken and the methods of evaluation. OT&E was expected to cost $17.5 million, with this funding provided by the Government in December 2011, and involving eight TVE firings:

- two deep water firings in the WAXA in March 2012; and
- six shallow water firings in the Northern Australia Exercise Area (NAXA) in September 2012.

4.16 Since the draft OT&E plan was first developed in 2009, the number of planned firings has been significantly reduced, as some Objective Quality Evidence had been received from the French Navy, and because the higher-than-expected cost of TVE firings involving the MU90 became clearer (see paragraphs 6.10 to 6.12). A comparison between the October 2009 draft and the finalised February 2012 OT&E plan is detailed in Table 4.3. The reduced number of planned OT&E firings reduced cost, but also reduced the opportunities to collect performance data in Australian conditions.[76]

[76] As discussed in paragraph 4.18, in the event, eight shallow water firings were conducted because of two failures.

Table 4.3

RANTEAA OT&E firing requirements, October 2009 and February 2012

Environment	October 2009 firing requirement (planned)	February 2012 firing requirement (approved)
Deep water firings	12 against submarine at various speeds and employing various degrees of countermeasures.	2 against submarine employing various degrees of countermeasures.
Shallow water firings	16 against submarine at various speeds and employing various degrees of countermeasures.	6 against submarine at various speeds and employing various degrees of countermeasures.
Warshot firings	1 warshot firing.	1 warshot firing.
Total firings	**29**	**9**

Note: All firings are TVEs except for the one warshot.

Source: ANAO analysis of Defence documentation.

The outcome of OT&E firings in March and September 2012 was the declaration of IOC in November 2012

4.17 The first round of OT&E firings conducted off the coast of Western Australia in the WAXA in March 2012 involved the firing of two TVE torpedoes[77] by *HMAS Warramunga*[78] in deep water against a Collins Class submarine. The Australian Maritime Warfare Centre considered the firings an overall success.[79] However, difficulties were encountered with accurately tracking the torpedo and submarine on the range, and one torpedo encountered issues with the consistency of its target tracking.

4.18 More recently, in September 2012, nine OT&E firings were attempted off the Northern Territory coast, in the NAXA. However, three torpedoes encountered problems during their runs. As at January 2013, investigations into two of these failures (which occurred soon after launch) by the torpedo manufacturer were ongoing. Additionally, one other torpedo failed to launch, and this failure was caused by the umbilical cord connecting the weapon to the combat system being loose with salt contamination evident. Defence assessed

[77] The exercise MU90 Torpedo (TVE) has the same mechanical and electrical interface and physical representation as the warshot (TC), but has an exercise section in lieu of a warhead. The TVE enables evaluation of the MU90 in-water performance.

[78] All OT&E firings for the MU90 have been conducted from *HMAS Warramunga*, an ANZAC class ship.

[79] The Australian Maritime Warfare Centre (AMWC) manages the sea firing ranges, data extraction from the exercise section of the torpedoes, and the subsequent firing analysis.

that the eight total firings provided sufficient data points to satisfy OT&E requirements.

4.19 RANTEAA advised the Chief of Navy in November 2012 that the OT&E firings demonstrated the MU90 torpedo's effectiveness. Chief of Navy subsequently approved IOC in November 2012.[80]

4.20 RANTEAA's advice to Chief of Navy highlighted that the final results from the total of 11 OT&E firings (two in the WAXA and nine in the NAXA) were:

- the shipborne surface lightweight torpedo system (which primarily incorporates the combat system and torpedo tubes—see Figure 1.3 for more detail) had a 91 per cent success rate in launching the MU90 torpedo;
- the MU90 torpedo had an 80 per cent success rate of operating correctly once launched; and
- the MU90 torpedo had an 88 per cent success rate at engaging the target when launched and operating correctly.

4.21 RANTEAA's final report on the OT&E firings (which formed the basis of the advice to the Chief of Navy regarding MU90 system performance) shows that, when measured from a whole of capability perspective (assessing all three criteria together), the overall MU90 lightweight torpedo system had a 64 per cent probability of success. This is slightly below the probability requirement set out in the JP2070 Detailed Operational Requirement (DOR). However, this is defined as an important requirement rather that an essential requirement that must be met. Defence informed the ANAO that the probability requirement has been met as the torpedo that did not fire in the September 2012 OT&E firings should be excluded from the reliability assessment, with that exclusion based on the fact that the testing was only concerned with in-water performance. The argument being that because the torpedo failed to fire and enter the water, it could therefore be excluded from the reliability calculation.

[80] IOC is the point at which the Capability Manager declares that the first subset of a capability can be operationally employed. Defence defines IOC for the MU90 as the capability to fire MU90 torpedoes from one FFG and one FFH, including: all onboard weapon handling and storage systems; the delivery of all integrated logistics support requirements; and the ability to conduct OT&E anywhere on the Australian station.

Planning for a warshot firing

4.22 To date, there has been no warshot (TC) firing of an MU90 torpedo by any user nation. The French Navy's plans to conduct such a firing have been continually postponed, with 2013 understood to be the current aim. RANTEAA's OT&E plan has scheduled a warshot firing in 2013, although the plan provides no additional detail about this. Given that the schedule for achieving IOC (November 2012) had been met, Navy have accepted the capability as fit for service prior to any warshot firing ever having been undertaken. This means that Navy would bear the risk should problems later arise with warshot performance.

4.23 The OT&E plan states that:

> It is essential that the RAN undertake at least one warshot firing to fully test the ADF ability to support the MU90 in service … This firing will fully demonstrate full end to end testing of the MU90 lightweight torpedo capability.[81]

4.24 Further, the Australian Navy's anti-submarine warfare training and firing manual states that warshot firings are required to validate the continuing performance of the warshot:

> The reliability of operational warstock is best validated through the conduct of live firing exercises. Live firings are the best source for providing data necessary for determining the probability of the weapon functioning correctly.

4.25 Defence's December 2011 submission to the Government sets out the importance of a warshot firing, and states that:

> The scope has been enlarged to incorporate additional test and evaluation activities (to assess torpedo performance against countermeasures, performance in warm shallow tropical water and *performance in an end-to-end test firing with a war shot torpedo*) ...
>
> ... an end-to-end MU90 war shot firing is planned to demonstrate the initiation and performance of a live warhead noting that this has yet to be undertaken by any user nation. [Emphasis added]

4.26 During audit fieldwork, DMO considered that 'participation' in the proposed French Navy firing would be sufficient to prove the concept of the

[81] End to end refers to the process from preparation of the torpedo, transportation, loading, launch and detonation.

warshot. The project office informed the ANAO of the benefits of participating in an overseas firing:

- as a cost saving measure;
- a TC firing needs to be preceded by a TVE firing, which will require an additional torpedo for OT&E;
- if an Australian warshot firing fails, Australia will have no peer-Navy support to assist in determining the cause, and will have less leverage over the original equipment manufacturer (OEM);
- an air launch, which is how the French Navy plans to test a warshot, is more difficult and complex but presents less safety risks for personnel[82]; and
- a warshot firing provides no greater insight than a TVE firing, except for the detonation. The aim of a warshot firing is only to produce an explosion.

4.27 In August 2012, a Project Management Stakeholder Group meeting raised the warshot firing issue, and agreed to fund the development and construction of a warshot target so that Navy can conduct an Australian warshot firing in the second quarter of 2013. Given the continuing uncertainty over French firing plans, including the extent of Australia's involvement, pursuing a local warshot firing represents a sound approach, and aligns with advice to the Government in the December 2011 submission. However, this firing will occur after the declaration of IOC in November 2012, which means that Navy will bear the risk should problems with the firing arise.[83]

MU90 torpedo trolley

4.28 Because the MU90 is heavier than the Mk46, FFGs require a torpedo trolley (see Figure 4.3) to safely move the MU90 torpedoes from the ship's weapons magazine to the torpedo tubes when at sea. The previous audit noted

[82] An air launch is not an option for an Australian test following the decision in 2009 to remove the remaining air platforms (the Seahawks and Orions) from the scope of JP2070.

[83] In the August 2012 Issues Papers for this audit provided to Defence, the ANAO included a draft recommendation that Defence plan to undertake a warshot firing as part of OT&E should access to a French warshot firing remain unclear. As a result of Defence's decision to undertake a firing, the recommendation is no longer required.

that the design and development of the trolley had been inadequate, with initial problems identified in 2004.[84]

4.29 Development problems with the trolley continued after the previous audit and have been subject to remediation actions specified in the remediation plan (see paragraph 2.6). In December 2011, a further prototype trolley was tested, overcoming stability and safety issues, although operational usage limitations still applied subject to testing of the first production trolley. Production of two trolleys subsequently commenced, and the first production trolley was delivered and tested in June 2012. This test resulted in approval to produce the remaining trolleys, which are due to be completed by April 2013.

4.30 The June 2012 test report shows that the trolley failed seven out of 27 requirements and three additional problems were identified. All 10 of these appear to be relatively minor, but must be resolved before full operational use can be granted. The failings involve problems that should have been resolved during prototyping and are a reminder of the problems that can be introduced by accelerated development due to a lack of early attention. DMO sought to have these problems rectified on the subsequent trolleys before delivery, with the two already delivered to be modified at a later date.

4.31 The final cost to the Commonwealth for the development of the trolley and the delivery of nine operational trolleys and spares is $2.03 million (2012 dollars), with an individual unit cost almost 10 times the original cost specified in the FRAA ($218 000 compared to $24 000).

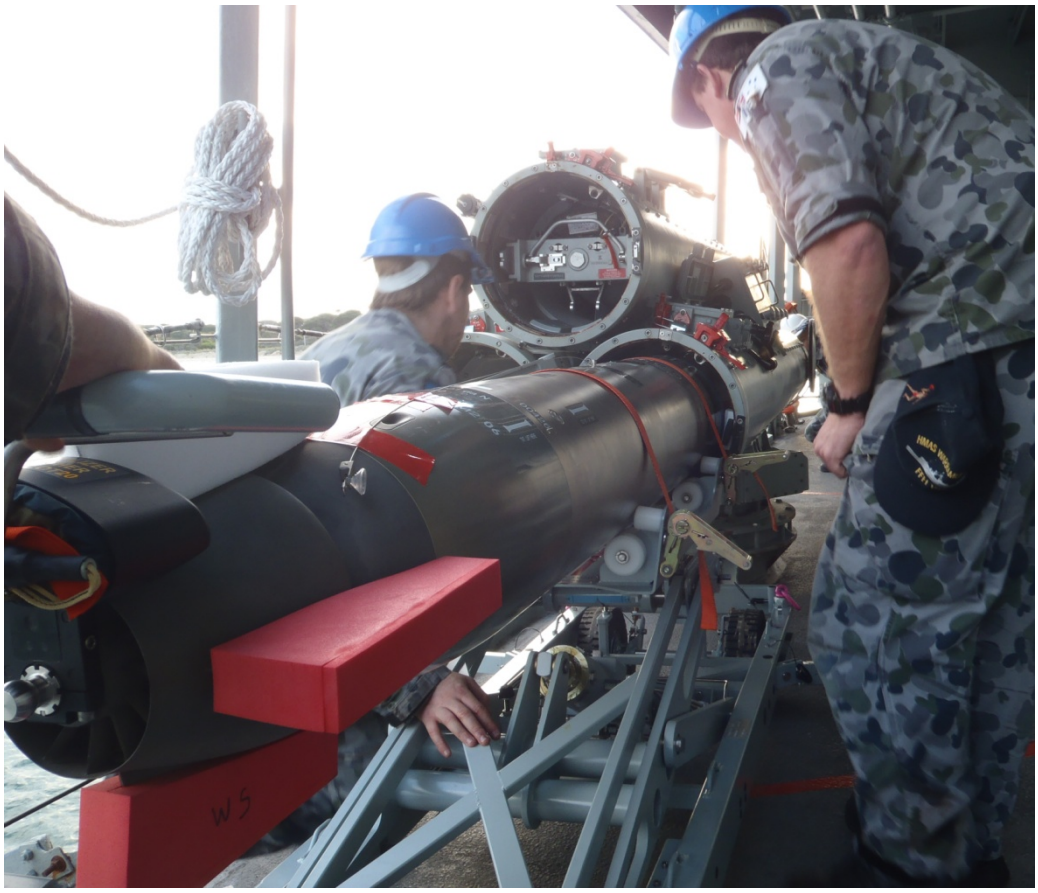
4.32 In January 2013, Defence informed the ANAO that:

> The final cost of the trolley needs to be balanced by the significant improvement to safety and stability achieved by that investment. The trolley required significant redevelopment from its original design to ensure it provided a fully work health and safety compliant and effective product. An ancillary benefit is the ability to use the trolley for the Mk46 torpedos with significant WHS benefits for all personnel required to handle that torpedo.

[84] ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, p. 145.

Figure 4.3

Torpedo being loaded into firing tube using torpedo trolley



Source: Defence photo.

Simulation

4.33 DSTO is the Australian Government's lead agency charged with applying science and technology to protect and defend Australia and its national interests.[85] DSTO provides Defence with scientific and technical advice on the development, acquisition and introduction into service of materiel. The August 2011 *Defence Capability Development Handbook* requires that DSTO provide, amongst other services, a Science and Technology Plan that documents the support DSTO is to provide a Defence project. The JP2070

[85] Defence Science and Technology Organisation, DSTO homepage, <http://www.dsto.defence.gov.au/> [accessed 13 June 2012].

plan highlights DSTO's central role in the selection and operation of the MU90 simulator.

4.34 Simulation is the use of artificial representation of real situations and equipment in order to provide the user with equivalent experiences to those gained from the use of the real situations and equipment. Weapon simulators allow users to assess the expected weapon performance and characteristics in different environments and scenarios.

4.35 With expensive weapon systems such as the MU90, reducing the need to conduct live firings will result in significant cost savings. As discussed previously, firing and refurbishing the MU90 TVE power source is expensive, time-consuming and hazardous. In addition, it can be difficult to coordinate the participation of all the necessary assets required to conduct test firings. Effective simulation has the potential to mitigate these difficulties.

4.36 It was identified very early in JP2070 that modelling and simulation would be required. The previous audit noted that, while a number of options had been considered, limited progress towards the acquisition of a modelling and simulation tool had been achieved. In 2009, simulation was identified as a critical requirement for the conduct of OT&E and ultimately capability acceptance. At the conclusion of the previous audit, work had been undertaken to develop simulation requirements and DMO planned to request a quotation during the second quarter of 2010. However, there continued to be a risk that this capability would not be available in time to support the then planned timeframe for achievement of IOC (mid 2011) due to the long lead time required to acquire and build expertise in the use of a simulation tool.[86]

4.37 DSTO developed a JP2070 simulation system statement of work in March 2011, which notes that simulation is a:

> Core capability required to support the effective employment of the MU90.

4.38 Notwithstanding the flexibility and value of computer-based simulation and its potential to reduce the extent of firings required, it is not sufficient in itself as it does not give users the benefits of hands-on, end-to-end testing of a system. An appropriate combination of simulation and actual usage/live firing provides the best balance for testing and developing a mission

[86] ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, pp. 42, 154.

system. The March 2011 DSTO simulation system statement of work acknowledges this, stating:

> There is no substitute for live firings. The advanced software employed by the MU90 and complex acoustic environments result in behaviour that is not easily predictable.

Simulator request for tender

4.39 In March 2011 DMO issued a request for quotes to the Djimindi Alliance for a MU90 simulator.[87] Two suppliers responded and were subjected to a tender evaluation. DSTO staff was responsible for conducting the technical evaluation of the simulation solutions offered. After assessing the tender responses in August 2011, DSTO considered that:

> It is quite evident that for the majority of high priority technical requirements, the tender responses do not provide a sufficient level of detail to make a preferential selection for either simulator.

4.40 Accordingly, the next stage of DSTO's evaluation involved undertaking site visits to investigate the respective simulators, and to visit users, including the German Navy. In an August 2011 site visit plan, DSTO noted that:

> The tender respondents have claimed requirement compliance for all of the Technical Priority 1 [*highest priority*] and most of the Technical Priority 2 [*next highest priority*] requirements. However, little supporting information is provided to back up compliance where claimed and it cannot be discerned how well the requirement is implemented in the tool.

4.41 The key priority was to ensure that the simulator would 'get the weapon through OT&E', and could be set up and supported by the OEM within the time frame required (an operational simulator was required by February 2012).

4.42 Following the site visits, DSTO produced a report recommending that DMO acquire the ORACOM simulator as offered by Whitehead Alenia Sistemi Subacquei (WASS), a member of Eurotorp. This was in spite of the supplier's

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[87] The request stated that:

> The CoA [*Commonwealth of Australia*] has a requirement for a software based MU90 Simulation System which accurately represents the torpedo 'in-water' behaviour and performance. It must also model the environment 'seen' by the torpedo, including both passive and active acoustics.
>
> The MU90 Simulation System will require initial support to enable the CoA to competently use the system for MU90 performance modelling and subsequent ongoing support for three years.

poor track record.[88] DSTO did, however, note that there were significant shortcomings in the ORACOM product and that:

> **neither simulator fully meets all requirements of the Australian MU90 Simulator FPS or provides all of the functionality that could be expected in a torpedo simulator**. [Original emphasis]

Simulator solution selected

4.43 The WASS ORACOM simulator was subsequently selected for purchase in November 2011, at a cost of $1.5 million (2010–11 MYEFO dollars). The DMO higher delegate submission seeking approval for the acquisition of the simulator noted that the solution had 'significant' technical and schedule risks. The simulator was delivered in April 2012, and DSTO expected to require approximately six months to understand and operate it effectively. Defence informed the ANAO that the simulator was used during OT&E.

4.44 There is currently no other navy that uses ORACOM for MU90 simulation, although the Italian navy has contracted WASS to perform MU90 simulations on its behalf using ORACOM. The absence of any prior experience with this tool for MU90 simulation increases the risks Defence faces in bringing it into service. In addition, there is no in-country supplier to provide support for ORACOM products. Support is only available from the original equipment manufacturer WASS, which is located in Italy.

4.45 Although simulation was identified early on as an important part of the lightweight torpedo capability, it did not receive priority over the course of the project. In the end, Defence has acquired a lightweight torpedo simulation capability for the MU90 that has no direct means to contribute to the Defence Simulation Strategy, which is based on connecting simulators across the ADF in order to more accurately simulate the battlefield situation (known as 'Federated Simulation').[89] The need for interconnecting simulators was officially articulated in the 2001 Defence Policy DIG OPS 42-1. Consequently, in 2004, Defence issued the Distributed Simulation Guide that provides advice and information on interconnection.

4.46 The 2011 *Defence Simulation Strategy and Roadmap* commented:

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[88] In 1999 DSTO obtained a VMS based version of ORACOM from WASS for $360 000 (1999 dollars) that was soon abandoned due to software coding errors, obsolescence and non-supply of mission software; the MU90 mission software was unable to be incorporated because of technical issues.

[89] Simulation Roadmap 2006 and Defence's Distributed Simulation Guide 2004.

> Despite reforms such as NCW [*Network Centric Warfare*], acquisition methods tend to acquire highly stove-piped solutions, with supporting elements such as simulation being focussed at a single training outcome or decision.

4.47 However, in January 2013, Defence informed the ANAO that:

> although in future, Defence seeks to establish simulation as an enterprise-wide, integrated capability with a combination of unique and configurable simulations that enable and support multiple capabilities and processes, this currently remains aspirational.

4.48 The ORACOM simulator as purchased by Defence is a stand-alone or 'stove-pipe' solution with no means of connecting to external systems or other simulators. WASS informed the ANAO in January 2013 that, whilst the networking option for ORACOM was on offer, Defence chose not to exercise the option due to a lack of information from DSTO.

4.49 Software simulation is merely an abstracted approximation of actual torpedo behaviour. More faithful behaviour is obtained by physically connecting actual torpedo hardware to a software simulator (known as a Hybrid/Hardware-in-the-loop simulator). These simulators provide more realistic and trustworthy results by minimising uncertainties and thereby producing higher fidelity behaviour. Hybrid/Hardware-in-the-loop simulators are, however, more expensive and difficult to transport.

4.50 As part of the Phase 1 Project Definition Study in 2001, Defence was quoted €1.5 million (January 2001 prices) for a more comprehensive Hybrid Simulator, but did not proceed with this option. In 2005, DSTO informed the JP2070 project office that without in-water trials, the best simulation is hardware-in-the-loop. Failing a hardware-in-the-loop simulator, DSTO advised that a high fidelity software simulator (such as ASIMUT, derived from the development simulator MAESTRO) appears to be the best choice. In its 2007 review of the TIAP firings, DSTO continued to recommend the use of high fidelity simulation.[90] However, notwithstanding DSTO's recommendation, and unlike the simulator for the Mk48 heavyweight replacement torpedo, the simulator Defence has acquired for the MU90 does not have a hardware-in-the-loop capability.

[90] Following performance issues in 2004, the French and Italian Governments required a series of test trials (known the TIAP program) to confirm the success of remediation activities undertaken on the torpedo.

4.51 Defence informed the ANAO in January 2013 that:

> ORACOM is lower fidelity than a hardware-in-the-loop simulation, but while hardware-in-the-loop does provide a higher fidelity it is high cost and resource intensive to establish and operate and the requirement for such a system needs to be assessed in terms of cost/benefit ...
>
> Additionally, there is no need for the acquisition of a hardware-in-the-loop simulator for the MU90 and it is well beyond the approved scope and cost of the project.

4.52 Given that MU90 exercise firings are a complex and expensive process (as discussed in Chapter 6), in this case a hardware-in-the-loop simulator may have represented a value for money investment if it could result in a reduced number of annual firings.

4.53 Software bugs were identified in the ORACOM version purchased by Defence and corrected in the current version (Release 1, Beta) with Release 2 due for use in May 2013. Defence informed the ANAO that WASS has been responsive in fixing the problems identified. However, it is clear that the simulator is not yet mature and remains under development, with latent defects or shortcomings presenting a real and ongoing risk.

Simulation life-cycle support

4.54 Defence policy on simulation (DI(G) OPS 42-1) issued in 2001 requires through-life-support for simulation capability. The support is required during the concept development, requirement definition, acquisition, in-service and disposal phases. This would be particularly pertinent should Defence wish to extend the life-of-type of the MU90 and thereby develop new or additional operational tactics supporting such an extension. Extending the life-of-type of equipment is not unusual within Defence in order to ameliorate capability gaps. However, Defence informed the ANAO in September 2012 that life-of-type extension is not within the scope of JP2070.

4.55 DSTO is largely responsible for the operation and maintenance of the simulator. The DSTO report on visits to overseas original equipment manufacturers of the two simulators considered by Defence (see paragraphs 4.40 and 4.42) indicated that DSTO is aware of the importance of future upgrades and that negotiations to this end would be required. Defence's purchase of the ORACOM simulator in February 2012 did not include any long-term support component or warranty extension. Defence advised in September 2012 that longer term support will be arranged through a separate contract—yet to be negotiated—or the existing Goods and Services Agreement

made in July 2012. The ANAO has examined the conditions of the agreement, including the IP rights, and noted that the agreement provides the Commonwealth with a license to 'use' the background IP. However, the usage rights are restrictive as it allows deployment of the simulator as an entity, but does not allow modification, reverse engineering or extension of the simulator software code.

4.56 Under current arrangements, Defence has no access to simulator software code and would therefore be unable to develop comprehensive in-house support such as writing new driver routines for moving onto different hardware, or develop extensions to provide simulator networking (see paragraph 2.14 for discussion of limitations in Defence's rights of access to background IP for the MU90).

5. MU90 Weapon Performance

This chapter examines the extent of Defence's understanding of the MU90 torpedo's performance, concluding with a brief examination of Defence's understanding of the Mk54.

Introduction

5.1 Defence defines capability as the 'capacity or ability to achieve an operational effect'.[91] JP2070 aims to deliver Defence an improved lightweight torpedo system to enhance the ADF's anti-submarine warfare capability. To develop a solution, the capability intended to be delivered is translated into requirements. Requirements are:

> Something that governs what, how well, and under what conditions a product will achieve a given purpose.[92]

5.2 This chapter examines progress made in verifying the performance requirements of the replacement lightweight torpedo capability. It concludes with a brief examination of Defence's understanding of the Mk54, the ADF's alternative new lightweight torpedo that is being procured as part of the acquisition of Romeo helicopters as the ADF's maritime helicopter (see paragraph 5.45).

Verifying performance of the torpedo

Status at the conclusion of the previous audit

5.3 At the time of the previous audit, verification of the MU90's performance remained incomplete. The FRAA, which was negotiated in 2005, did not require the Djimindi Alliance to conduct any PDT or TVE firings as part of acceptance testing and evaluation. Consequently, DMO had responsibility for acceptance testing, which was still ongoing at the conclusion of the previous audit. The previous audit highlighted three areas of risk that would impact directly on Defence's ability to complete OT&E of the torpedo:

- the lead time required to obtain a simulation model;

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91 Department of Defence, *Defence Capability Development Handbook*, Canberra, August 2011, p. 2.

92 Electronic Industries Alliance, *Process for Engineering a System*, Electronic Industries Alliance Standard 632, Virginia, 1999, p. 67.

- the lack of a valid target; and
- access to sufficient Objective Quality Evidence (OQE) for Prior Qualification of the torpedo.[93]

5.4 The issues with the acquisition of a suitable simulation model are discussed in paragraphs 4.33 to 4.53. The issues in relation to a target and access to OQE are discussed in subsequent sections of this chapter.

5.5 Where DMO determines that requirements specified in JP2070 capability definition documents are unable to be met, or are unable to be tested, DMO is required to obtain agreement from Navy and Capability Development Group (CDG) for capability deviations or waivers, as they deviate from the agreed project capability baseline agreed by government. Requests for deviations relate to a proposed amendment to a specific requirement (such as reducing a requirement's frequency or performance), while waivers seek to have a requirement removed altogether because it cannot be met or tested. DMO informed the ANAO that it may also take into account cost and time pressures to rectify non-compliance when seeking waivers.

5.6 At the time of the previous audit, it had been established that the air integration requirements would not be met, with the remaining air platforms having been removed from the scope of JP2070 in early 2009. High risks around target and range requirements had also been identified. Since then, other instances of non-compliance with mandated requirements have arisen or been confirmed (see paragraphs 5.25 to 5.35).

Using the Collins Class as a 'not to hit' target for test and evaluation

5.7 A key element of testing the performance of the torpedo is the availability of an appropriate target to conduct test and evaluation. Problems acquiring an adequate mobile target for the MU90 have been evident since

[93] The previous audit noted that:

> ABR 6492 Naval Technical Regulation Manual (July 2003) notes that OQE provides assurance that the [demonstration of the] individual requirements have been assessed by a competent authority. OQE can take a number of forms ranging from test results to formal certificates issued by a classification society. The Project Certification Plan should document what OQE is required, who should assemble and provide this OQE and who should review the OQE.

ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, p.150.

2002, when a study found that the targets then available to the ADF were the Collins Class submarine and a simulated submarine target, with the latter not sophisticated enough for the MU90. Over time, Defence has explored various target solutions for test and evaluation of the MU90.

5.8 Provisional endorsement of the safety case for using the submarines as a 'not to hit' target was received from the Navy Submarine Safety Board in December 2010, and final approval was received in August 2011. Delays progressing to OT&E meant that the Collins Class was certified in time for the first OT&E firings, conducted in March 2012. The availability of operational platforms is a common risk to the completion of OT&E; however, a submarine was available for both sets of OT&E firings, although submarine serviceability issues resulted in a minor delay to the beginning of the NAXA firings.

5.9 The decision to use the Collins Class as a target for OT&E left the project with $10.6 million in funding for a target that was no longer required. In March 2011, Defence received approval from the Government to use this funding for initial in-service support, for which funding was otherwise due to expire that month. This re-scoping was needed because of continuing delays completing the Stage 2 submission to the Government for approval to re-allocate remaining quarantined air integration funds (see paragraph 3.30). The re-scope extended in-service support until the end of 2011, and the Government subsequently approved Stage 2 funding in December 2011.

Range tracking

5.10 The previous audit noted that the ADF's underwater ranges, which are used to track and record weapon performance during trials, cannot track the MU90.[94] The JP2070 budget does not include funding for the acquisition of suitable ranges.[95]

5.11 Third party tracking is able to partially mitigate this deficiency, and Defence can use the torpedo's in-run analysis and recording capability to reconstruct the weapon path and performance. However, Defence has accepted that the lack of proper integration with ADF ranges will not be resolved during the life of the JP2070 project.[96] Defence informed the ANAO in August 2012 that the range requirements are in the process of being removed from the FRAA via a contract change proposal.

5.12 Workarounds have been developed for tracking the MU90, such as sensors, portable signature management equipment, and airborne recording/monitoring by an AP-3C Orion. The main risk is locating weapons that do not run to their programmed endpoint. As set out in Table 5.2, in September 2011 the range tracking requirements set out in the Detailed Operational Requirement (DOR) and Function and Performance Specification (FPS) were formally waived, although a Defence working group was formed to explore options to meet the intent of the DOR tracking requirement.

5.13 The December 2011 PMSG was informed that a suitable workaround has been agreed upon and refinement of the deployed method was to be achieved during OT&E. However, the workaround enables torpedo location not the more dynamic torpedo tracking, and is therefore more limited.

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[94] As noted in the previous ANAO audit, in March 2005 the then Minister was informed that the MU90 torpedo is not compatible with existing ADF ranges but that there was an ongoing investigation into whether a modification to the weapon would overcome this issue. It was subsequently determined that these modifications to the MU90 torpedo could not occur.

In response to the current ANAO audit, Eurotorp informed the ANAO that:

> [*In*] the FRAA SoW [*Statement of Work*] the MU90 exercise section modification in order to use the MU90 on the Australian fixed range was included; the CoA [*Commonwealth of Australia*] finally decided not to do this modification and to use sonobuoys for tracking the torpedo which is a far less precise system.

[95] Instead, it was originally intended to acquire ranges through a separate unapproved project that was planned to be considered by government in 2004–05. However, in May 2004, the JP2070 project was informed that the shallow water tracking range had been removed from the scope of that project.

[96] For more background see the discussion of ranges in the previous audit report: ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, p. 155.

5.14 The inability to fully utilise Defence tracking ranges means that Defence is reliant solely upon the torpedo's recorded data to accurately reconstruct its run path. However, accessing all the recorded data was not straightforward. In March 2012, Eurotorp was tasked to develop a procedural document defining all the data fields and workings of the torpedo, to allow Defence to download and interpret all torpedo run data without assistance from Eurotorp. This is important, as the OT&E firings occur against Collins Class submarines, and recorded data includes sensitive signature information.[97] This breakdown was not available for the March 2012 OT&E firings. Defence was subsequently supplied with software and instructions on extracting the required run data prior to the OT&E firings in Northern Australia in September 2012.

Meeting capability requirements: the need for Objective Quality Evidence

5.15 Objective Quality Evidence (OQE) is qualitative or quantitative evidence relating to the performance of the MU90 torpedo and the shipborne surface lightweight torpedo system (SLWTS) that Defence can use to form a judgement that a requirement has been met. This evidence may come from Defence's own analysis or testing, data provided by OEMs, or data provided by other users.

5.16 To verify the performance of the torpedo itself (excluding the SLWTS and other equipment and services), all relevant requirements in the FPS require OQE in the form of Prior Qualification (PQ) based on factory acceptance testing. Factory acceptance testing is the first stage of acceptance testing and is normally complemented by later types of acceptance testing, such as system integration testing and test firings.[98] The JP2070 FPS defines PQ as follows:

> (Prior Qualification) – Is used to verify compliance with requirements via reference to previously qualified requirements. In this particular case [*the*]

[97] Accurate submarine signature information enables the location and tracking of submerged submarines.

[98] Verification can occur through eight different test categories, which are grouped into the three phases of test and evaluation: developmental (category 0), acceptance (category 1 to 5), and operational (category 6 and 7). Acceptance testing and evaluation incorporates factory acceptance testing (category 1); environmental qualification tests (category 2); system integration testing (category 3); harbour acceptance testing (category 4); and sea acceptance testing (category 5).

method is used when a FPS requirement is able to be traced to previously signed off requirement.

5.17 PQ in this case refers to requirements previously proven by Eurotorp and other users of the torpedo. Relying on PQ to verify requirements is suitable if it includes higher level acceptance testing, and the materiel being procured is off-the-shelf and already in service with other countries, which Defence originally thought the MU90 was. To illustrate, there are no PQ requirements for the SLWTS specified in the FPS, reflecting the fact that no other MU90 user nations operate the same naval platforms as the ADF. Accordingly, Defence will need to rely on its own work to verify and validate the performance of the SLWTS on its platforms. For the SLWTS, factory acceptance testing is the most common verification method. However, factory acceptance testing is complemented by the latter categories of AT&E.

Verification Cross Reference Matrix

5.18 The JP2070 Verification Cross Reference Matrix (VCRM) captures the status in verifying requirements from capability definition documentation, referencing the OQE used as the basis of a passed requirement. VCRMs are an output of the DOORS® system, the requirements management software used by the Djimindi Alliance to track the status of requirements in capability definition documentation and other derivative specifications. Table 5.1 lists the status of JP2070 requirements as at September 2012.

Table 5.1

Requirements traceability

VCRM (last updated)	Number of requirements	Requirements status
Torpedo & support equipment (October 2011).	192 requirements	147 passed 1 pass 12 passed with waiver 31 open 1 fail[(A)]
Surface lightweight torpedo system (September 2011).	190 requirements	102 passed 77 pass 1 passed with waiver 10 open

VCRM (last updated)	Number of requirements	Requirements status
Torpedo Maintenance Facility (TMF) and the mobile Post Exercise Facility (PEF(M)) (October 2011).	125 requirements	119 passed 2 passed with waiver 3 open 1 fail(A)

Source: ANAO analysis of JP2070 Verification Cross Reference Matrixes.

Notes: There is a difference between 'passed' and 'pass': passed' means the requirement has been agreed to be passed by Defence; 'pass' on the other hand means that Eurotorp/Djimindi Alliance are claiming the requirement has been satisfied but it is yet to be verified and accepted by Defence.

(A) The failed requirements relate to the torpedo trolley.

5.19 The table shows that the TMF and PEF(M) requirements have largely been satisfied. While only slightly over half the SLWTS requirements have been passed, the Alliance is confident it has sufficient evidence to satisfy the majority of the remaining requirements.

5.20 For the torpedo and support equipment VCRM, as at September 2012 (prior to OT&E testing in the NAXA) over half of the open requirements (including the one 'pass' requirement) related specifically to the performance of the warshot torpedo. Only one-third of the total number of warshot performance requirements had passed. As noted in paragraph 5.16, under the FPS all these warshot requirements are PQ based on factory acceptance testing (category 1 testing). Such requirements should have been verified well before the conduct of OT&E. Because they had not been verified, these requirements have been, or will be:

- subject to waivers prior to completion of OT&E;
- tested during OT&E (category 6 testing), although firings and modelling may not provide enough evidence to fully verify requirement; and/or
- lack sufficient evidence to pass, resulting in failures or further waivers.

5.21 The majority of torpedo performance PQ OQE cited in the VCRM is not held by Defence because it has been highly classified by the French Government. The primary PQ documents cited are:

- the Torpedo Technical Specification (the STG, the French equivalent to the FPS); and

- the French document that traces compliance with the STG: the 1996 Design Substantiation Document (the DJD, the French equivalent to a Verification Cross Reference Matrix).

5.22 Like the VCRM, the DJD traces the French requirements traceability to the appropriate evidence, and does not include the actual evidence itself. Other sources of evidence cited in the DMO VCRM include qualification summary reports and firings undertaken by Australia and elsewhere (for example the TIAP firings). These latter sources of evidence are preferred, as they are more detailed and specific, although there are fewer of these reports cited.

5.23 Since the previous ANAO audit, DMO has been more proactive in its attempts to obtain evidence from Eurotorp and foreign navies to support verification, and some additional information and documentation has been received. The DJD was received by DMO in early 2010 and translated into English in late 2010.

5.24 The PQ listed for MU90 torpedo performance requirements—as cited in the DJD and VCRM—is primarily developmental and factory acceptance testing conducted in the 1990s during development by members of Eurotorp, not all of which is held by DMO. Some of this information has been provided by the French and Italian governments, and DMO has been required to translate this information into English. DMO has also received some reports from French Navy MU90 firings, which may form part of the OQE used to verify some requirements.

Limitations in Objective Quality Evidence results in deviations and waivers of capability requirements

5.25 In May 2010, the JP2070 project office identified a number of requirements in the DOR and FPS that either:

- could not be met due to the design/capability of the MU90 torpedo and support system; or
- were considered no longer appropriate or relevant.

5.26 The project office wrote to CDG requesting waivers or deviations for these requirements. This request was eventually addressed by CDG, in consultation with Navy, in September 2011. Table 5.2 shows the key requirements that were amended.

Table 5.2

Key changes to JP2070 capability requirements, September 2011

Requirement/Issue	Basis of Request	CDG determination
Torpedo transmitter is not compatible with RAN ranges.	Too expensive to upgrade torpedo. Recommend that future range upgrades consider integrating the MU90 acoustic transmitter.	Permanent non-compliance agreed.
Recovery of TVE & PDT torpedoes possible up to sea state 5, whether by firing ship or recovery vessel.(A)	Firing ships no longer recover fired torpedoes (whether MU90 or Mk46): recovery done by contractor. Recovery vessels used in the past for Mk46 are inadequate, MU90 requires larger vessel with a crane. Because fired torpedoes are recovered by lifting onto the ship using a crane, contractor unable to recover and lift torpedoes above sea state 3.	Permanent non-compliance agreed.
Number of TVE torpedoes available for firing yearly and peak period (2 week) availability.	Preparation and refurbishment of TVEs is very expensive (approximately $400 000 per torpedo(B)) and time consuming (90 days notice to prepare, one week to conduct preparation, one month to refurbish once fired).	Number required to be available reduced.
Number of PDT torpedoes available yearly and peak period (2 week) availability.	Annual availability number too difficult due to labour requirements.	Number required to be available reduced.
Air integration requirements.	Air integration was removed from project scope by Government.	Permanent non-compliance agreed.

Source: ANAO analysis of Defence documentation.

Notes: (A) Sea state refers to the agitation of the sea resulting from various factors such as wind, swell and currents. Sea states are based on an ascending 10 point scale (0 to 9), each containing a descriptive term and height of wind waves in the open sea. Sea state 5 is described as 'rough' seas with waves of 2.5–4 metres. Sea state 3 is described as 'slight' seas with waves of 0.5–1.25 metres.

See World Meteorological Organization, *Manual on Codes*, Volume I.1, pp. A–216, A–326.

(B) $400 000 was the cost cited in project office minute to CDG. The current estimate of this cost is now $317 000 (see paragraph 6.32).

5.27 The need to reduce the number of TVE and PDT firings required per year arose due to the relatively higher complexity of the torpedo. The JP2070 DOR (which listed the firing requirements) was produced in 2001, well before Defence understood the high cost and level of effort involved in exercise

firings. The revised annual and peak period firing requirements are only 33 per cent and 40 per cent of the original requirements, respectively.

5.28 The reduced sea state recovery level limits the sea environments in which Navy can conduct test firings, impacting on the ability to test the torpedo in a representative environment. The result is that exercise firings of the older Mk46 torpedo can be conducted in rougher seas than for the MU90, because the MU90 needs to be lifted, rather than dragged, onto a recovery ship (as the torpedo may be damaged). The need for a larger recovery vessel is due both to the need to crane the torpedo aboard and the flushing requirements of the TVE (see paragraph 6.8).

Greater understanding of torpedo performance requirements leads to additional request for capability waivers

5.29 In mid 2011, DMO highlighted the requirements from the STG (using the recently translated DJD) and FPS that it considered to be torpedo performance requirements. These were then reviewed in conjunction with CDG and Navy, when the highlighted performance requirements were confirmed and the means of achieving the required data fidelity to verify compliance was defined. As a result, it was established that a number of FPS performance requirements would be unable to be fully verified by existing evidence and the then upcoming OT&E program. In December 2011, DMO wrote to CDG identifying over one-third of the warshot torpedo FPS performance requirements which could not, or may not, be verified by the OT&E program due to the following testing limitations:

- environmental conditions;
- the range of some tests;
- cost; and
- Defence not possessing the equipment or capability that forms the basis of some tests.

5.30 The DMO project office concluded that these limitations would result in limited actual firing data. This led to multiple performance requirement waiver requests, most falling into the broad categories of:

- the torpedo's detection, classification and interception of submarines; and

- the torpedo's performance in particular operating conditions.[99]

5.31 Most waiver requests state that the MU90 simulator will be used to the extent possible, although DMO acknowledges that limited actual firing data will mean the simulation model's accuracy and fidelity will be unable to be fully verified.

5.32 In August 2012, CDG (after consulting with Navy) approved all but one of the requested waivers, with one unapproved on the basis that a waiver was unnecessary as the requirement will likely be met.

5.33 Obtaining waivers from specific capability requirements is an accepted part of capability acquisition, and is certainly not limited to JP2070. Additionally, in the case of the MU90, many waivers are sought not because the torpedo cannot necessarily meet the requirement, rather that Defence is unable to test or fully verify that the torpedo can meet the requirement. However, deviating from the capability baseline increases the risk that the capability will not meet the Navy's original expectations.

5.34 Many of the requirements in the December 2011 deviations request are important anti-submarine warfare torpedo performance requirements. The inability to fully verify key MU90 performance requirements represents a risk that meeting key operational effectiveness and suitability issues, documented in the Test Concept Document, Test and Evaluation Master Plan and OT&E plan, becomes less certain. Some requirements, however, may be able to be tested at later dates as part of Navy's yearly TVE firing program; Navy currently plans to conduct five TVE firings per year.

5.35 In February 2013, DMO provided an update to the ANAO on the progress in verifying warshot torpedo performance requirements after the OT&E firings. DMO expected that the results of OT&E, modelling and additional analysis would provide evidence to verify all but one of the outstanding requirements that had not been subject to waivers, however these findings were yet to be finalised. Waived requirements will not be verified, however DMO has collected evidence that goes part way towards demonstrating compliance with the waived requirements.

[99] These categories have been generalised to avoid the publication of sensitive information.

Conclusions on OQE and PQ

5.36 Since the previous audit, good progress has been made in verifying the requirements for the SLWTS, TMF and PEF(M). However, most of the performance requirements relating to torpedo performance remained open prior to OT&E. Over one-third were waived as performance requirements by CDG after consultation with Navy. Most were tested to some degree by OT&E, although the firing and modelling data obtained was inadequate to verify the requirements. The OT&E program served to verify AT&E requirements, which normally should be finalised prior to OT&E. Cost and schedule constrained the number of OT&E firings, limiting the opportunities to further collect additional OQE.

The ADF's mixed inventory of MkI and MkII torpedoes

5.37 As at February 2012, production of the first batch of Australian-produced MkII torpedoes was about to commence, with delivery due in September 2012.[100] While the intention of Defence's August 2009 decision to accept two-thirds of the Phase 3 warstock in MkI configuration was to maintain or improve the Phase 3 schedule, the schedule has still encountered delays since then for three reasons:

- The need to halt production during OT&E. The personnel involved in producing the torpedoes in Australia are required to assist the OT&E program, specifically the preparation and refurbishment of the torpedoes to be used.
- Negotiations to amend the FRAA to incorporate additional in-service support for spares, as well as support for OT&E, were protracted and resulted in a delay to the Phase 3 Final Materiel Release date.[101]
- Warshot assembly was delayed due to quality assurance issues with European components, and shortcomings in the assembly process. This related to poor quality inspection processes with European torpedo warheads and the failure of a number of locally assembled MkII torpedoes.

[100] Torpedo assembly and testing is performed at the TMF situated in Fleetbase West, HMAS Stirling. The facility is manned by a combination of Commonwealth (mostly DMO) and contractor (mostly Thales) personnel.

[101] Final Materiel Release (FMR) is a milestone that marks the completion of the delivery of all products and services specified in a project's Materiel Acquisition Agreement (MAA).

5.38 Ultimately, Defence received limited benefit from accepting MkI torpedoes in lieu of MkII torpedoes under Phase 3. Delivery of the first third of the Phase 3 torpedoes did occur ahead of what would have been the case if these were MkII torpedoes, by approximately nine months. However, subsequent schedule delays mean that the current Phase 3 schedule, as amended in February 2012, is for final delivery of warshot torpedoes in April 2013, an eight month delay compared to the final delivery date of June 2012 as specified in the April 2010 MAA (which was signed after the decision was made to take two-thirds of Phase 3 warstock as MkI torpedoes).

5.39 While the decision to make changes to the torpedo ratio was made with the intent of improving the Phase 3 schedule, the more critical driver for delivering the MU90 capability was progress with Phase 2. Phase 2, essentially, involves integration of the MU90 onto the ANZACs and FFGs—that is, making sure the ANZACs and FFGs can store and fire the torpedo.

Future upgrade of torpedoes

5.40 In May 2010, Defence representatives travelled to France for discussions with representatives of the French Navy, Italian Navy, Direction générale de l'armement (DGA—the French equivalent of DMO) and Eurotorp on various aspects of the MU90. Based on these discussions, the Director of RANTEAA noted that:

> There is no planned development path for the torpedo. The approach is to only examine any future development if funds become available. Should funds become available any development will only apply to the Mk [*II*] weapon. We therefore potentially will have a number of obsolete weapons in our inventory.

5.41 The subsequent May 2010 PMSG discussed the difference between the MkI and MkII weapons:

> The benefit of the MkII variant is its capacity for upgrade due to greater processing power than the MkI variant other than this there were very minor obsolescence issues to differentiate the two Mk's. France does not have any current plans for upgrade beyond MkII and there is no funding allocated to an upgrade program.

5.42 The OEM currently has no plans for further development of the MU90 beyond the MkII variant. The MkI core software will not be further developed, as it is incompatible with the MkII due to an outdated central processing unit and less digital memory. This means that potentially, the MkI will become obsolete earlier than the MkII (if software development out strips the MkI

hardware limits). Given the physical differences between the two, there is a real possibility that it is simply infeasible to upgrade the MkI to MkII because too many changes are involved and in any case Defence has not costed this.

5.43 Obsolescence is also an issue for the MkII. According to a 2011 MU90 International Logistics Working Group—comprising representatives from Italy, France, Germany and DMO—the MkII may have obsolescence issues post 2014, as there is no plan after this date for obsolescence monitoring of the MkII.

5.44 The ANAO notes that the torpedoes are expected to remain in-service until 2038. Therefore, the ADF has a large stock of MkIs that are likely to become obsolete sooner than the MkII, while the MkII may also face obsolescence issues in the near future. Due to limited access to background IP, Defence will not be able to further develop any of the MU90 versions by itself. However, Defence informed ANAO in January 2013 that it is unlikely it will want to further develop or modify the torpedo by itself.

The decision to acquire another lightweight torpedo: the Mk54

5.45 The Mk54 is the lightweight torpedo developed by the United States to replace the older Mk46, which is also currently in service with the ADF. Defence is procuring Mk54 torpedoes as part of the acquisition under AIR9000 Phase 8 of maritime combat helicopters (MH-60R Seahawk *Romeos*), associated support systems, and weapons to replace the existing capability provided by the Navy's 16 aging S-70B-2 Seahawks, and the capability that was to be delivered under the cancelled Super Seasprite project. The Government approved this acquisition in May 2011. Defence's submission to the Government did not raise the possibility of integrating the MU90 onto the *Romeo*, and no funding was allocated for this. Defence informed the ANAO in January 2013 that:

> While the cost of maintaining two inventories is significant, the cost of integrating a complex European weapon (the MU90) onto a US helicopter for the first time cannot be underestimated in its impact on schedule, capability and cost. A decision was made within the acquisition strategy for AIR 9000

Phase 8 to avoid weapon integration risk, noting the Mk54 was already integrated and certified on the SH60R aircraft.[102]

5.46 In 2009, DSTO performed a qualitative (desktop) analysis of the Mk54, and compared it to the MU90. The main Mk54 data used in that evaluation originated from a 2004 US test report. The DSTO report considered that the Mk54 and MU90 had broadly similar capabilities. The 2004 US report is the most up-to-date evidence Defence possesses on the Mk54. Defence informed the ANAO in March 2012 that this 2009 DSTO report was used to inform the Government's Second Pass consideration of the options for AIR9000 Phase 8.

5.47 The AIR9000 Phase 8 Second Pass submission to the Government noted that both the MU90 and Mk54 met the ADF's requirements and 'were considered comparable in capability'. However, the accompanying acquisition business cases for each helicopter, under the heading 'performance aspects' for both torpedoes, noted that there are 'technical issues that will need to be accepted or managed through the life of the aircraft'. The DSTO AIR9000 Phase 8 *Second Pass Technical Risk Assessment* stated that there were several fitness-for-purpose issues associated with both the torpedoes and torpedo systems but noted these were highly classified and so had been included in a classified annex.

5.48 This classified annex made several observations on the technical nature and performance of both torpedoes. However, this report, written in November 2010, still relied upon the same 2004 US test report mentioned above for data on the Mk54, with no new data available. Given the age of the data, this presented significant limitations in understanding the current status of the torpedo. For some of the issues examined in the classified annex, there was a lack of performance information for both the MU90 and Mk54.

Gaps in understanding of both torpedoes remain

5.49 In September 2011, DMO sought DSTO assistance to undertake a study of the Mk54, including its viability, suitability, sustainment costs, and a 'side by side comparison of the Mk46 versus the Mk54 versus the MU90'. After consultation between DSTO and CDG, in November 2011 DMO was informed that this was a capability issue, and the request was out of DMO's scope (and

[102] Eurotorp informed the ANAO in January 2013 that:

> Integration costs of the MU90 on aircraft cannot be compared to the additional costs to support two different torpedoes during 20 or 30 years.

within CDG's). In November 2011, CDG determined that the study would not be supported as its purpose was unclear, and insufficient data existed on Mk54.

5.50 Later in November 2011, DMO's Director Navy Guided Weapons System Program Office informed CDG that the study was required to inform the upcoming submission to the Government seeking Stage 2 funding for JP2070. CDG replied that:

> CMOD [*Chief Maritime Operations Division—DSTO*] and I have previously discussed this task, and given the respective workloads of our two teams we have assessed and assigned this task as low priority - to be pursued when detailed Mk 54 data comes online via AIR 7000 and AIR 9000 over the next couple of years. Until we gain access to classified Mk 54 performance data any comparative assessment would be nugatory at best, and not represent any considered Departmental position to allow a valid VFM [*value for money*] argument to be mounted. Equally, we do not hold accurate MU90 performance data against which to make an effective comparison. Therefore, the study will be completed when DSTO and CDG personnel, data and resources become available.

5.51 In response to this exchange of emails, CMOD informed his DSTO colleagues that:

> My view is that without performance data on either the MU90 or the [*Mk*]54 or the ability to accurately model their performance the best we could do is guess (an educated guess I do admit) but without valid information on these weapons I don't see how we can assist.
>
> I think we should stick to our agreement with [*CDG*] and work on this problem when [*Mk*]54 data becomes available as part of [*AIR 7000*] and [*AIR 9000*] and after we have completed a few more [*MU*]90 firings.

5.52 Other DSTO officials also noted the lack of additional information beyond that provided in the 2009 DSTO report, leaving no basis to change their assessment that the two weapons are broadly similar.

5.53 Given Defence's current lack of performance information on the Mk54, and the continuing gaps in understanding of the MU90, there is limited documented evidence to support Defence's comments in the AIR9000 Phase 8 Second Pass submission to the Government that the two torpedoes met the ADF's requirements and 'were considered comparable in capability'. No additional data on the Mk54 was received as part of the process to develop the Second Pass proposal for AIR9000 Phase 8.

6. Sustainment of the MU90

This chapter examines the process for MU90 exercise firings and the costs of firing and sustaining MU90 torpedoes, comparing these to other torpedoes in the ADF's inventory. This chapter also highlights the implications of supporting two very different lightweight torpedo systems (the MU90 and Mk54) into the future.

Introduction

6.1 The life cycle of a capability encompasses several phases: definition, acquisition, in-service, and disposal. The previous chapters focused on activity during the acquisition phase. This chapter examines the operational and financial issues that will impact on torpedo use and sustainment during the in-service phase, which is planned to run until approximately 2038.

Process for MU90 exercise firings

6.2 Undertaking an exercise firing for the MU90 is a complex and expensive process. It requires coordination between multiple parties, as shown in Table 6.1.

Table 6.1

Parties involved in an exercise torpedo firing for OT&E

Party	Service provided
DMO & Thales personnel from Torpedo Maintenance Facility (TMF)	Torpedo preparation and refurbishment.
	Operation of the mobile Post Exercise Facility if firing outside of the Western Australia Exercise Area (WAXA).
ADF clearance divers	Assistance for torpedo location and recovery.
Defence Maritime Services (contractor)	Torpedo recovery vessel.
Navy fleet personnel	A firing platform (to date this has been *HMAS Warramunga*).
	A Collins Class submarine, to be used as a 'not to hit' target.
Australian Maritime Warfare Centre	Manage the sea firing ranges, extracts data from exercise torpedo, undertakes firing analysis.
RAN Test Evaluation Acceptance Authority	Managers of OT&E.
Air Force	Aerial tracking of the torpedo (using an AP-3C Orion).

Party	Service provided
Joint Logistics Command	Transporting the torpedoes and the mobile Post Exercise Facility.
DSTO	Responsible for pre and post trials analysis using the torpedo simulator.

Source: ANAO analysis of Defence documentation.

6.3 The MU90 is an electrically driven torpedo utilising an electrochemical Aluminium Silver Oxide based power source (battery). After each exercise firing of a TVE, the torpedo must be safely recovered and the power source fully flushed and stabilised before being transported back to the TMF for refurbishment. Practice torpedoes are not propelled and therefore do not require flushing, but they do require some maintenance after each firing.

6.4 In the lead-up to a firing, torpedoes need preparation. This involves testing of components, a service of the torpedo and replacement of some parts. Torpedoes are then transported to the firing site, with the mobile Post Exercise Facility (discussed from paragraph 6.15) also required to be transported for firings outside of the WAXA.

6.5 Once an exercise torpedo has been fired and completed its run (or a practice torpedo has been fired) its flotation collar will inflate to ensure it does not sink. The exercise torpedo then vents for an hour, expelling the majority of electrolyte, undissolved caustic soda and residual gases.[103] After one hour of torpedo flushing at sea, it is considered safe to approach and proceed with torpedo recovery.

6.6 A contracted recovery team secures the exercise torpedo (see Figure 6.1), and loads it onto a special purpose recovery vessel (see Figure 6.2 and Figure 6.3). The primary method of recovery is the Eurotorp-designed 'Shark Safe Recovery System' (SSRS): a steel frame which is locked around the torpedo and used to manoeuvre the torpedo around and onto the ship (visible in Figure 6.1 and Figure 6.2).[104] The January 2011 Explosive Ordnance Design Assessment noted that the SSRS has not passed a design review, and mandated that this be done prior to in-service use for ocean recoveries. However, as at

[103] When an exercise weapon finishes its run, its propulsion motor stops and the weapon enters 'torpedo flushing' mode, which draws in sea water to flush out these hazardous products.

[104] The backup recovery method for exercise torpedo recovery is a net recovery system developed by DSTO. As at the end of September 2012, this backup recovery system had not received final design approval. For practice torpedoes, an approved alternative recovery method involves using a tow rope.

the end of September 2012, the SSRS had not received design approval despite the completion of all planned TVE firings for OT&E.

Figure 6.1

Securing the torpedo using the Shark Safe Recovery System (SSRS)

Source: Defence photo.

Note: The orange band is the torpedo's flotation device.

Figure 6.2

Loading torpedo onto recovery vessel

Source: Defence photo.

Note: The picture shows an exercise torpedo already recovered and secure on a ship rinsing station, with the second torpedo being lowered onto another ship rinsing station.

6.7 The recovery vessel for a MU90 TVE is supplied by a contractor who provides the ADF with sea-based recovery services. The *MV Seahorse Standard* (see Figure 6.3) is currently the only vessel equipped to recover the MU90.[105] A MU90 recovery ship must be large enough to accommodate flushing rigs and associated equipment, and a suitable crane (to recover the torpedo). Defence approved $2.5 million (December 2012 price basis) to fund DMS recovery services for OT&E.

[105] This vessel is operated by DMS Maritime Pty Limited for torpedo recoveries on the west coast and in Northern Australia. This vessel can also recover Mk46 torpedoes, which can also be recovered by the significantly smaller DMS Maritime Pty Limited Fish Class torpedo recovery vessel (*Tailor*). Defence intends to seek the modification of another ship (the *MV Seahorse Horizon,* also operated by DMS Maritime Pty Limited) for MU90 torpedo recoveries for firings on the east coast of Australia.

Figure 6.3

MU90 exercise torpedo recovery vessel

Source: Defence photo.

Note: *MV Seahorse Standard* with a submarine rescue vessel, participating in a naval exercise.

6.8 Once recovered from the sea, additional flushing of the exercise torpedo takes place aboard the *MV Seahorse Standard* to ensure any remaining electrolyte, undissolved caustic soda or gases are purged from the torpedo. Removing a TVE from the sea, placing it on the ship rinsing station and recommencing flushing must take no longer than 10 minutes, otherwise the torpedo is at risk of overheating. Flushing then needs to occur for 16 hours before the torpedo can be disassembled safely. It is then transported back to either the mobile Post Exercise Facility or TMF, depending on the location of the firings.

6.9 Based on the manufacturer's recommendation, each torpedo may only be fired in TVE configuration on three occasions before the torpedo must be consigned to warstock use only, due to the rapid deterioration of component parts.

The cost of conducting an MU90 exercise firing

6.10 The October 1999 source evaluation report for Phase 1 of JP2070 stated that the cost per MU90 exercise torpedo firing would be $16 000, comprising

$15 000 of spares and 20 man-hours. The subsequent November 1999 Defence Source Selection Board report stated that:

> The 'turn around' cost of practice weapons is the most significant lightweight torpedo lifecycle 'cost driver', and considered to be a more suitable indicator of prospective value for money than acquisition costs. The 'turn around' costs proposed by TMS's [*Thomson Marconi Sonar—supplier of the MU90*] are based on actual firings and in production items, and are likely to be firm costs, whereas the Bofors, Mar[c]oni and USN [*United States Navy*] 'turn around' costs are not considered as firm due to the developmental nature of the proposed weapons.

6.11 Given the Defence Source Selection Board's statement that the 'turn around' cost of practice weapons is 'the most significant lightweight torpedo lifecycle 'cost driver'', and that Defence effectively eliminated consideration of any alternative torpedo when it decided to sole-source the Phase 1 Project Definition Study to the supplier of the MU90, it was important that the Board's assessment of these costs was based on accurate information. It was not. As identified in the previous audit, Defence found during 2004 and 2005 that the MU90 was developmental, not in-service.

6.12 As early as 2004, a meeting of the PMSG identified that the high cost of torpedo firings would mean that acceptance into naval service of the MU90 would not follow a regular process. The previous audit also noted that a refurbishment kit, required for an exercise torpedo after each firing, cost approximately $330 000 at the time.[106] The July 2011 review of the project estimated that turn-around cost would be $419 000. The most recent cost estimate for the total cost of an exercise torpedo turnaround is approximately $317 000. The turn-around cost has reduced primarily because refurbishment procedures and exchange rate have improved. This estimate includes parts and the labour of the TMF personnel, but not the cost to Navy and the cost of recovery services provided by Defence Maritime Services.

[106] ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, p. 152.

Comparing exercise firings of the MU90 and Mk46

6.13 A comparison of the exercise firing process for the MU90 and Mk46 is set out in Table 6.2. It shows that firing an MU90 exercise torpedo is considerably more involved and costly than firing an Mk46. Three significant issues are:

- the cost per firing ($317 000 for the MU90 compared to $116 000 for the Mk46);
- the need for a portable exercise facility for the MU90 for firings outside of Western Australia; and
- the need of a larger recovery vessel for the MU90 for firings outside of Western Australia.

Table 6.2

Comparison of Mk46 to MU90 for exercise torpedo firings

Issue	Mk46	MU90
Recovery of exercise torpedo	Fish Class Torpedo recovery vessel (100 tons displacement). Mk46 torpedoes can also be recovered by the *MV Seahorse Standard*.	*MV Seahorse Standard* (4000 tons displacement).[107]
Maintenance of torpedo away from the WAXA/TMF	Maintenance can be conducted without mobile Post Exercise Facility.	Mobile Post Exercise Facility required.
Approved modes of transport of torpedo	Land, sea and air.	Land and sea (approval for air transport yet to be received).
Number of maintenance hours required for exercise firing	120	540
Time required to conduct firings	6 firings in 2 days.	6 firings in 10 days (3 firings every 5 days).
Number of firings capable – per torpedo, before refurbishment required	Once(A)	Once
Cost per firing	$116 000	$317 000

[107] Smaller ships may be used for MU90 recovery, however the *MV Seahorse Standard* is the only ship equipped with sufficient deck space and a suitable crane currently available under existing Defence contractual arrangements for MU90 recovery for west coast and northern Australia firings.

Issue	Mk46	MU90
Range tracking	Can be tracked on AUS Navy ranges.	Cannot be tracked on AUS Navy ranges, workarounds required.
Firing overseas	Can be tracked & fired at US ranges.	It is unclear whether the torpedo can be used overseas because of IP issues (see paragraph 2.21) and the need for the mobile Post Exercise Facility (see paragraph 6.15).

Source: ANAO analysis of Defence documentation.

Note A: For practice (unpropelled) torpedoes, the Mk46 can be fired 20 times before refurbishment is required, while MU90 PDTs require return to a maintenance facility for refurbishment after each firing.

6.14 The high cost and complexity of an MU90 exercise firing may well place pressure on Defence's capacity to meet its annual exercise firing requirements in the future.

The mobile Post Exercise Facility

6.15 Facilities are required close to exercise and trial firing sites to refurbish the MU90 for subsequent re-use. In Western Australia (for firings in the WAXA), the TMF serves this purpose. For firings outside this area—notably in the NAXA—Defence and Thales under JP2070 Phase 3 developed the mobile Post Exercise Facility (see Figure 6.4 and Figure 6.5).

6.16 The facility is made up of two shipping containers: one is a workshop and the other stores equipment, allowing maintainers to handle and work on exercise torpedoes using appropriate procedures and support equipment. This facility is required for all exercise firings outside of the WAXA. A mobile facility was developed in lieu of a permanent facility along the east coast of Australia, as a cost-effective solution that can more readily service the NAXA.

Figure 6.4

Outside view of mobile Post Exercise Facility

Source: Defence photo.

Note: This picture shows a torpedo being loaded into the facility.

Figure 6.5

Inside view of mobile Post Exercise Facility

Source: Defence photo.

6.17 The facility provides the ability to:

- refurbish a fired practice torpedo for re-use (allowing PDT firings away from the TMF);
- complete the post-run flushing process, clean and service a fired TVE;
- preserve TVEs for return to the TMF for refurbishment; and
- extract post-firing data from both practice and exercise torpedoes.

6.18 At the time of the previous audit, the mobile facility was due to be delivered in June 2010 and tested in late 2010. The November 2010 AT&E firings in the WAXA (see paragraph 4.11) also tested the facility in Western Australia. The facility was successfully used to turnaround two PDTs and stabilise one TVE. DMO subsequently accepted the facility in February 2011.

6.19 For OT&E firings, DMO informed RANTEAA in March 2011 that:

> One of the most significant choke points to the rate of MU90 Exercise Torpedo (TVE) firings in the NAXA is the capacity of the Post Exercise Facility (Mobile) (PEF(M)).

6.20 Defence informed the ANAO in September 2012 that the facility can support three TVEs every five days.

6.21 Prior to the September 2012 OT&E firings conducted in the NAXA, the facility had yet to be used at capacity or outside Western Australia. The facility was successfully used for the NAXA firings and successfully supported the eight exercise firings in a three week period.[108] This included supporting five exercise firings on one day, more than originally anticipated. The facility proved successful, when supported by a sufficient number of personnel. Reporting on the facility's performance, the Director of RANTEAA advised Chief of Navy that:

> The PEF(M) requires a hardstand, power and water facilities and these facilities were funded by [*the JP2070*] Project and constructed at Darwin Naval Base (DNB). The concept proved to work very well for torpedo pre-embarkation activities and post-run stabilisation and teardown activities. The logistic footprint to achieve MU90 exercise torpedo (TVE) preparations, firings, recovery and post-run routines is very large in terms of assets, manpower cost and transport to support the PEF(M) concept.

[108] As noted in paragraph 4.18, a ninth torpedo failed to launch because the umbilical cord connecting the weapon to the combat system being loose with salt contamination evident.

6.22 The mobile Post Exercise Facility provides more flexibility than having a fixed facility on the Eastern Seaboard (which was the original intention). The need to build, maintain and transport the mobile facility, however, is a product of the unique and demanding maintenance requirements of the MU90 (especially the flushing requirements).

Budgeting for ongoing torpedo use: personnel and operating costs

6.23 Separate from the cost of procuring military equipment (covered by a project's budget) are personnel and operating costs. These incorporate Defence staff costs during the project's acquisition (which are not provided for under a project's budget), and the staff and equipment costs associated with the use of the equipment over its life (excluding any initial supply of spares provided as part of a contract), including decommissioning the equipment at the end of its life.

6.24 Defence will incur a range of salary costs directly related to introducing the MU90 capability into service that are not part of the JP2070 project budget, including in various parts of DMO and Navy, as well as CDG and DSTO. During both the previous and current audits, Defence has been unable to identify the salary costs related to JP2070 work undertaken by these various parts of Defence.[109] Defence informed the ANAO in September 2012 that 'There would be significant costs and major changes required to Defence's enterprise system to enable this information to be captured'.

6.25 When reporting on expenditure (both internally and externally, such as in Annual Reports), Defence focuses on the project budgets for new and upgraded capability. However, personnel and operating costs in the Defence context are also significant. Audit Report No.34 2011–12 *Upgrade of the M113 Fleet of Armoured Vehicles* (pp. 83-84) found that personnel and operating costs will account for almost 50 per cent of the estimated total whole-of-life cost for

[109] For discussion of project salary costs in the previous audit, see ANAO Audit Report No.37 2009–10 *Lightweight Torpedo Replacement Project*, pp. 182–184.

the upgraded M113 capability. Other reports have highlighted a similar, or greater, figure.[110]

6.26 In determining personnel and operating costs for a new or upgraded capability, Defence calculates the net difference between the estimated actual personnel and operating costs for the capability being replaced and those it estimates relate to the new capability being acquired. This amount is referred to as the Net Personnel and Operating Costs (NPOC). In the case of the MU90, the NPOC relates to the difference in costs between operating the Mk46 and the MU90 (for surface vessels). A good understanding of existing personnel and operating costs is therefore required for a sound estimate of the NPOC for a replacement capability. Defence's estimates of Mk46 personnel and operating costs are approximately $2.4 million per year, from 2012–13 to 2018–19.

6.27 The most up-to-date NPOC estimate for JP2070, which was used in the December 2011 Cabinet submission, was developed in 2008 and provides for $67.1 million (2008–09 constant price) over ten years (2008–09 to 2018–19).[111] This is in addition to the allocation for the Mk46. The majority of the funding will be used by DMO for the ongoing maintenance and sustainment of the torpedoes (discussed from paragraph 6.31).

6.28 Personnel and operating costs have not been projected for the whole life of the torpedo, which is currently planned to be withdrawn from service in 2038. While the need to accurately estimate (as far as possible) whole-of-life costs and advise these to the Government is documented in Defence policies and procedures, Defence's capacity to do so has been judged deficient in various reviews of Defence, as shown below.

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[110] A February 2012 United States Government Accountability Office report stated that, in respect of the United States Department of Defence, operating and support costs have generally accounted for between 60 and 80 per cent of a weapon's total cost. See United States Government Accountability Office, *Defence Logistics: Improvements Needed to Enhance Oversight of Estimated Long-term Costs for Operating and Supporting Major Weapon Systems*, Report to the Subcommittee on Readiness, Committee of Armed Services, House of Representatives, GAO-12-340, February 2012, p. 1.

The 2008 Audit of the Defence Budget (the Pappas Review) noted that 'operating and support costs are around half the total whole-life cost of military equipment'.

The 2003 Kinnaird Review noted that 'Over two thirds of the whole-of-life cost of defence platforms or weapons systems are incurred after introduction into service – it is even higher for major maritime platforms'.

[111] DMO informed the ANAO in February 2013 that this 2008 estimate also projected out the expected NPOC to 2029–30. The estimates for 2019–20 to 2029–30 were between $7.5 million and $9.3 million annually (2008–09 outturned prices). NPOC was not included in government budget approvals for Phase 2 or Phase 3 of JP2070, and Defence's December 2011 submission only advised government of the $67.1 million NPOC cost out to 2018–19.

6.29 In response to the Mortimer Review recommendation, Defence advised that it would implement a robust system and apply annual updates to NPOC.[112] However, there has not been any subsequent review or update of NPOC costs for the MU90 since 2008.

6.30 The ANAO has recommended (see paragraph 6.50) that there would be benefit in Defence updating the estimated personnel and operating costs of the ADF's lightweight torpedo capability across their planned whole-of-life cycles. Such a contemporary update of the MU90's cost estimates should:

- Extend across the torpedo's whole planned life (to 2038). Defence has currently budgeted personnel and operating costs for the Mk46 until 2018–19, therefore MU90 costs beyond this date will increase as there is no existing funding to build upon.
- Include all Defence groups (including Navy and DSTO) and update those previously budgeted for (DMO and Defence Support Group).
- Take into account the more mature understanding of torpedo sustainment acquired by the Torpedo Maintenance Facility (TMF) over time (including the cost of components, the labour effort required, and would include maintaining the support and test equipment). See paragraph 6.37.
- Take into account the pattern of maintenance, with the cost and effort required varying over time according to the torpedo's maintenance schedule (see paragraph 6.42 and Table 6.4).
- Be based on a firmer understanding of Navy's costs and level of effort, given the eight OT&E firings conducted and the formalised requirement for a set number of firings per year (see paragraph 6.36 and Table 6.4).
- Be based on actual usage and deployment of the mobile Post Exercise Facility, as part of the September 2012 OT&E firings in Northern Australia.
- Take into account the gradual planned retirement (FFGs and FFHs) and introduction into service (AWDs) of surface platforms that utilise the MU90.

[112] Department of Defence, *The Response to the Report of the Defence Procurement and Sustainment Review*, May 2009, p. 32.

Firing and sustainment costs

6.31 As part of the July 2011 review of JP2070 (see paragraph 3.21), the DMO Torpedo Maintenance Facility (TMF) developed a comparison of the cost to fire and maintain the ADF's current and future torpedoes: the MU90, Mk46, Mk54, and Mk48 (the ADF's heavyweight torpedo). Table 6.3 uses these costings to compare the cost and effort required for firing an exercise version of each torpedo. The costs are only those incurred by the TMF for individual firings, and do not include Navy or support services such as torpedo recovery, which are procured from a contractor. In a torpedo inventory, a heavyweight torpedo is commonly more labour intensive and expensive to maintain than a lightweight torpedo.

Table 6.3

July 2011 comparison of costs for ADF torpedo usage

Torpedo Type (basis of costs & hours)	Exercise weapon turnaround (man-hours, per weapon)	Cost per firing of exercise weapon (equipment & labour)
Mk46 (actual usage) – lightweight	120	$116 000
Mk54 (estimate) – lightweight	130	$134 000
Mk48 (actual usage) – heavyweight	440	$327 000
MU90 (estimate) – lightweight	700	$419 000

Source: ANAO analysis of DMO operational costs prepared for: *Report of Independent Review of JP 2070 – Light Weight Torpedo Replacement*, July 2011.

6.32 In June 2012, the estimated turnaround cost for an MU90 exercise weapon had reduced from approximately $419 000 to $317 000, as:

- the estimated number of man-hours required had reduced from 700 to 540 based on an increased understanding of the torpedo and its support requirements (see paragraph 6.37); and
- the exchange rate against the Euro (the source currency for the procurement of exercise refurbishment kits) had improved.

6.33 However, these figures remain well above the initial turnaround cost estimate of $16 000 in the October 1999 source evaluation report for Phase 1 of JP2070 (see paragraph 6.10), even after accounting for inflation.

6.34 The relatively higher complexity of the MU90 is directly reflected in the turnaround cost for firing an MU90 exercise torpedo compared to the Mk46 or

Mk54, and indeed even compared to the Mk48 heavyweight torpedo. DMO advised RANTEAA in March 2011 that:

> Preparation of a single [*MU90*] TVE takes three trained personnel eight working days and 20 working days to refurbish.

6.35 The current estimated annual cost of maintaining the ADF's heavyweight and lightweight torpedo inventory, including the Mk54 once the torpedoes for the Sikorsky MH-60R Seahawk *Romeos* being procured under AIR9000 Phase 8 have been delivered, is outlined in Table 6.4. The basis of the costs varies according to the number of torpedoes held in inventory, the maintenance regimes of each torpedo family, and the varying exercise/practice firing requirements.

6.36 For the MU90, the most expensive elements are the refurbishment kits required after every exercise firing and as part of a warshot torpedo's 10.5 year service (see Table 6.4 for more explanation). The kits currently cost approximately $231 000 and $256 000 respectively.[113] Five exercise torpedo and 34 practice torpedo firings per year are Navy's current requirements for the MU90. Consistent with the figures in Table 6.3, Table 6.4 incorporates labour, material and equipment costs for the TMF only (not Navy or support services such as recovery). DMO's estimates as at August 2012 are that the cost to support one MU90 warshot torpedo as warstock inventory is almost double the cost for one Mk54, and is more than double the cost for one Mk46.

[113] Refurbishment kits are procured from Eurotorp, and current costs are based on an exchange rate of $1AUD = €0.73. The originally budgeted cost of the kits, based on the FRAA contract base exchange rate ($1AUD = €0.59), were approximately $305 000 for an exercise firing kit and $338 000 for a 10.5 year service kit.

Table 6.4

Annual maintenance cost of torpedo inventory

Item	Mk46	Mk54 (estimates)	MU90	Mk48 (heavyweight)
Number of TMF maintainers required to support inventory.	5	4	8.4	19
Total labour cost (including maintainers, management & other support directly attributed to sustainment of the weapons).	$1.5 million	$1.3 million	$1.8 million	$3.5 million
Spares, material and maintenance / refurbishment kits.	$0.9 million	$1.2 million	$4.8 million	$5.8 million
Total annual cost of maintaining inventory	**$2.4 million**	**$2.5 million**	**$6.6 million**	**$7.3 million ($9.3 million if ACP is included)**[A]
Number of annual planned exercise and practice torpedo firings.	13 exercise 6 practice	12 exercise 6 practice	5 exercise 34 practice	40 exercise n/a practice

Source: TMF documentation.

Note A: Mk48 costs include the cost of Defence support to the Mk48 Armaments Cooperative Project (ACP). The Mk48 ACP is a joint partnership between the Commonwealth of Australia and the United States Navy for the development, production and through-life support of a replacement heavyweight torpedo. The Project is planned to be completed in 2015–16. Supporting the ACP adds approximately $2 million in personnel and equipment costs.

6.37 The estimated cost of sustaining the MU90 has increased over time as the TMF has refined its costings, based on an improved understanding of the torpedo, the support it requires and the maintenance requirements of associated support equipment. These most recent estimates (May 2012) have increased approximately $1.2 million over March 2012 estimates, primarily as additional kit spares and maintenance of support and test equipment have been taken into account. As part of this costing refinement, the frequency and cost of some maintenance regimes have also changed. The TMF originally estimated it would take 700 hours to turnaround an exercise weapon, however this has now been reduced to 540 hours.

6.38 Defence will have the opportunity to further refine its estimates of firing and turnaround costs for the exercise weapon after the completion of OT&E, as it will be able to draw on an additional eight Australian firings. This

includes six firings in Northern Australia, which will have also incurred the additional costs of deploying and using the mobile Post Exercise Facility.

Impact of MU90 torpedo complexity

6.39 In any torpedo inventory, heavyweight torpedoes are generally expected to cost more to use and maintain than a lightweight torpedo. The relatively high operating costs of the MU90 are directly attributable to its capability and technical features. WASS promotes the MU90 as the leader of third generation torpedoes, stating it was built 'with the most advanced technology'.[114]

6.40 With advanced technology there is often an increase in complexity. For instance, compared to the simple Otto-cycle propulsion system used in the Mk46 and Mk54, the MU90 uses a complex propulsion system based on a highly energetic electrochemical power source. Concomitant with the MU90 power system's high energy capacity is its relatively short lifespan: an MU90 torpedo can only be fired as a TVE three times due to the rapid deterioration of component parts, after which it must remain as a warshot torpedo only. Whilst this power source provides for an extended range when compared to the Mk46 and Mk54, it also means maintenance is considerably more elaborate and costly (see paragraphs 6.2 to 6.9 for an overview of the process for MU90 exercise firings).

6.41 The increased complexity of the MU90 propulsion system impacts directly on its maintenance schedule. Torpedo maintenance and inspection regimes are governed by various technical documentation and manuals produced by Defence and Original Equipment Manufacturers (OEMs). As part of this maintenance regime, different component parts are replaced and disposed of as required. The annual costs are averaged out over yearly requirements. However, in reality, labour and cost requirements will vary depending upon the schedule of torpedo maintenance. DMO is seeking to reduce this impact by staggering torpedo servicing.

6.42 The TMF conducts two routine MU90 servicing operations. Every 3.5 years the warshot torpedoes require servicing, and every 10.5 years they need a major service involving a total strip-down and reassembly of each torpedo,

[114] For a summary of the torpedo see: WASS, *MU90 Impact ALWT*, 2008 brochure, <http://www.wass.it/WASSWEB/brochure/MU_90.pdf> [last accessed 22 June 2012].

replacing parts such as rubber seals, the electrochemical stack and the sodium hydroxide electrolyte.[115] The majority of these items are also replaced after a TVE run.

Impact of having different lightweight torpedoes in the ADF inventory

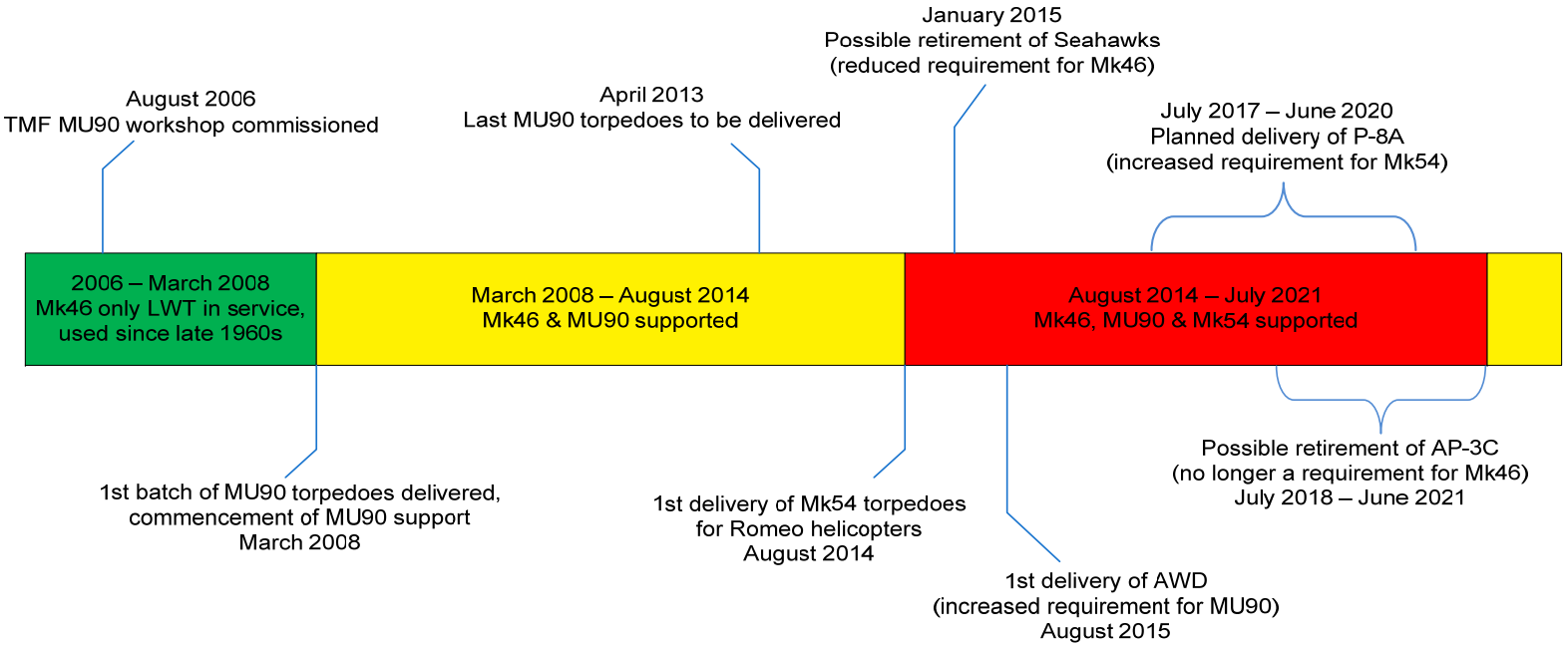
6.43 Additional storage and labour pressures will be placed on Defence because it will be supporting an inventory of three different lightweight torpedoes between late 2014 (when the first deliveries of MH-60R helicopters and their Mk54 torpedoes are made) and up to mid-2021 (a possible retirement date for the AP-3C Orion, which uses the Mk46), as shown in Figure 6.6).

6.44 The TMF is planning to dispose of the Mk46 inventory (incorporating both Mod1 and Mod5A (SW) torpedoes) progressively between July 2012 and June 2021. However, some Mk46 torpedoes may need to be sustained for longer if there are delays to the introduction into service of the P-8 Poseidon (which will replace the AP-3C Orion).

[115] Torpedoes are kept in warshot configuration when in storage, then converted to exercise configuration as required.

Figure 6.6

Timeline of support for ADF lightweight torpedoes



Source: ANAO analysis of Defence documentation.

6.45 Compounding this situation is the inability of Defence to fully leverage off the staff, equipment and procedures in place for maintaining the Mk46 in relation to maintaining the MU90. This is because of the different national origins and makeup of the torpedoes. The US International Traffic in Arms Regulations (ITAR) and IP restrictions require that the two torpedoes be stored and managed separately, with limited people having access to both torpedoes.[116] In contrast, the Mk54 is an evolution of the Mk46 and will have a large degree of commonality in parts, equipment and procedures. That said, the need to sustain both the Mk46 and the Mk54 for a period will have a labour and sustainment cost impact that Defence has yet to accurately assess. As at September 2012, Defence did not know the costs to sustain the Mk54, although it expects these costs to be only marginally higher than for the Mk46.

6.46 Maintaining a mixed inventory of very different lightweight torpedoes, such as the Mk series and the MU90, adds complexity and cost. In this case, the need for Defence to maintain a mixed inventory has largely arisen because the lightweight torpedo is a key sub-system of maritime helicopters and the helicopter platform selected by Defence for this role comes equipped with Mk54 rather than MU90 torpedoes. In this context, Defence wanted to avoid the potentially large integration costs and risks to schedule associated with integrating the MU90 onto the preferred helicopter platform (the Sikorsky Seahawk *Romeo*). To avoid the kinds of problems that have occurred in the past, where Defence has sought 'Australianised' capability solutions that have involved integrating different sub-systems onto otherwise military off-the-shelf platforms, the decision was taken to acquire the Sikorsky Seahawk *Romeos* configured with the same subsystems and weapons it has in operation with the United States Navy.

6.47 Defence's Capability Development Group also considers that there are tactical advantages for submarines practicing against different lightweight torpedoes, noting that:

> CN [*Chief of Navy*] has clearly articulated his intention to introduce the MU 90 as his SLT [*ship launched torpedo*], and the Mk 54 as his ALT [*air launched torpedo*] from embarked aircraft, therefore we have little/no room for debate [*over supporting three different lightweight torpedoes*].

[116] ITAR are US regulations established under Section 38 of the US *Arms Export Control Act*, which controls the export and import of defence articles and services. See: *ITAR Part 120 – Purpose and Definitions*, <http://pmddtc.state.gov/regulations_laws/itar_official.html> [accessed 10 October 2012].

6.48 However, Defence is facing significant financial constraints over the next several years and maintaining the MU90, the Mk46 and the Mk54 torpedoes has personnel and facility implications for the TMF, which is currently having difficulty maintaining a full complement of Commonwealth staff. Given that the Mk54 torpedoes are now expected to commence delivery in late 2014, there would be merit in Defence analysing the full implications of operating its mixed inventory of lightweight torpedoes so as to position itself appropriately to identify and manage the potential cost, technical workforce and facility implications.

6.49 In this context, at the August 2012 Project Management Stakeholder Group meeting the Director General Navy Capability Transition and Sustainment stated that:

> It was broadly accepted that the mix of torpedo types to be maintained in inventory was not envisaged when the lightweight replacement project [JP2070] was stood up. The complexities of maintaining multiple torpedo types need to be articulated to the upcoming JP2070 Gate Review and the PMSG.

Recommendation No.1

6.50 The ANAO recommends that, to inform its management of the ADF's lightweight torpedo capability and to inform future Defence budgets, Defence undertakes an appropriate analysis of the potential costs (including personnel and operating costs), technical workforce and facility implications of operating its mixed inventory of lightweight torpedoes across their planned whole-of-life cycles.

Defence's response:

6.51 *Agreed.*

Ian McPhee — Canberra ACT

Auditor-General — 28 February 2013

Appendices

Appendix 1: Recommendations from the previous ANAO audit

The ANAO made three recommendations in the previous audit. While the recommendations were derived from findings in relation to JP2070, they were not specific to the Lightweight Torpedo Replacement Project. Instead, they focused on governance arrangements for alliance style contracts, verifying the development status of equipment prior to committing to acquisition, and the management of programmatic risks to projects across Defence and the DMO.

Recommendation No.1:

The ANAO recommends that Defence and the DMO review governance arrangements surrounding alliance-style contracts to confirm that reporting arrangements, external to the alliance, provide effective oversight of alliance and project performance.

Defence and DMO response: Agreed

Recommendation No.2:

The ANAO recommends that the DMO review its tendering arrangements with a view to ensuring that sufficient objective or independent evidence is obtained to enable verification of any claims that an item being offered is 'off-the-shelf', prior to the selection of the preferred tenderer.

Defence and DMO response: Agreed

Recommendation No.3:

The ANAO recommends that Defence and the DMO implement appropriate mechanisms to identify and address programmatic risks associated with projects that are modifying a number of platforms.

Defence and DMO response: Agreed

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