

The Auditor-General
Audit Report No.34 2011–12
Performance Audit

Upgrade of the M113 Fleet of Armoured Vehicles

**Department of Defence
Defence Materiel Organisation**

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of Australia 2012

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Canberra ACT
24 May 2012

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 in accordance with the authority contained in the Auditor-General Act 1997. I present the report of this audit, and the accompanying brochure, to the Parliament. The report is titled *Upgrade of the M113 Fleet of Armoured Vehicles*.

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

A handwritten signature in black ink, appearing to read 'Ian McPhee', is positioned above the printed name.

Ian McPhee
Auditor-General

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

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Abbreviations

AA	Armoured Ambulance
ACV	Armoured Command Vehicle
ADF	Australian Defence Force
ALV	Armoured Logistics Vehicle
AM	Armoured Mortar
ANAO	Australian National Audit Office
APC	Armoured Personnel Carrier
ARVL	Armoured Recovery Vehicle
ASLAV	Australian Light Armoured Vehicle
CCP	Contract Change Proposal
CDF	Chief of the Defence Force
CEO	Chief Executive Officer
CSP	Commercial Support Program
CSSR	Cost Schedule Status Reporting
DGLMS	Director-General Land Manoeuvre Systems
DLOC	Directed Level of Capability
DMO	Defence Materiel Organisation
DPPM	Defence Procurement Policy Manual
ELF	Enhanced Land Force
FF	Fully Functional

FIC	Fundamental Inputs to Capability
FOC	Final Operational Capability
GFE	Government Furnished Equipment
HLS	Head of Land Systems
HNA	Hardened and Networked Army
IED	Improvised Explosive Device
IPV	Initial Production Vehicle
JCPAA	Joint Committee of Public Accounts and Audit
JLU(V)	Joint Logistics Unit – Victoria
MLOC	Minimum Level of Capability
MRB	Materiel Review Board
OLOC	Operational Level of Capability
PCA	Physical Configuration Audit
PRR	Production Readiness Review
RAR	Royal Australian Regiment
RU	Restricted Use
SRP	Standard Repair Price

Summary and Recommendations

Summary

Introduction

1. The M113s are a family of tracked vehicles, the most common variant of which is the Armoured Personnel Carrier (APC). The other six variants are: the Armoured Fitter (AF), the Armoured Recovery Vehicle Light (ARVL), the Armoured Logistics Vehicle (ALV), the Armoured Ambulance (AA), the Armoured Command Vehicle (ACV) and the Armoured Mortar (AM).¹ They are the Australian Defence Force's (ADF's) only tracked vehicles available for transporting and providing close-combat support for infantry in battle. The M113's primary function is to allow Army to effectively mount close-combat operations in a variety of threat environments, including by protecting the lives of the soldiers who rely on the vehicles as one of their main tools of battle.

2. The Department of Defence (Defence) is currently upgrading 431 of its aging fleet of over 700 M113s, which first saw service during the Vietnam conflict in the 1960s. The upgrading of the M113s commenced in 1992, with the decision to undertake a \$50 million minor upgrade of the entire fleet to provide an interim capability until a replacement vehicle could be developed and produced.² However, successive changes to the scope of the upgrade commenced almost immediately and by 2001 government had approved instead a project³ to undertake a major upgrade of 350 M113s at a cost of \$594

¹ The AF repairs vehicles in the field; the ARVL recovers vehicles from the field; the ALV transports equipment and supplies; the AA transports wounded troops; the ACV provides a field command post and communications hub; and the AM provides transport and support of an 81mm mortar.

² Land 400—Land Combat Vehicle System (LCVS)—is a replacement of the M113, Bushmaster Protected Mobility Vehicle and the Australian Light Armoured Vehicle (ASLAV). Defence describes the current Land 400 project as: 'the Army's largest, most expensive [currently expected to be greater than \$10 billion] and most complex major capability equipment project to date. The project aims to deliver the mounted close combat capability to the Land Force from 2025. LAND 400 will provide an integrated suite of land combat vehicle systems to fill the mounted close combat capability gap that is partially being enabled by a number of disparate existing light armoured vehicle fleets. The Land 400 Initial Operational Capability (IOC) is planned for 2025–26 and is currently planned to be one Armoured Cavalry Regiment of Land Combat Vehicle Systems (LCVS). Given the early stage of the project, the IOC is expected to become more defined as options to meet the capability requirement are sourced through the First to Second Pass process'.

³ The full title generally used by Defence for the project in current publications (including on its internet sites) is 'Upgrade of M113 Armoured Vehicles LAND 106'. In this report it is generally referred to as the M113 upgrade project.

million (October 2001 base date dollars).⁴ The Major Upgrade Contract was originally signed with Tenix Defence Pty Ltd in 2002,⁵ however in June 2008 Tenix Defence was purchased by BAE Systems, which is now the Prime Contractor.⁶

3. In August 2006, the Government approved Stage 1 of the Enhanced Land Force (ELF) initiative, designed to provide an increase in land force capacity to assist the ADF sustain multiple operations. Army's then only mechanised infantry battalion, 5th/7th Battalion Royal Australian Regiment (RAR), was subsequently split in December 2006 to form two mechanised infantry battalions (5 RAR and 7 RAR) in the 1st Brigade (1 Brigade). In October 2008, the Government approved a proposal, as part of implementing ELF, to purchase an additional 81 upgraded M113 APCs under the Major Upgrade Contract so that 5 RAR and 7 RAR could operate M113s exclusively, rather than a mixed fleet of M113s and Bushmasters. The estimated total cost of the additional 81 vehicles was \$222.1 million (2008–09 budget out-turned prices).⁷

4. In 2010–11, the total approved budget for the major upgrade project stood at \$884.3 million (2010–11 budget out-turned prices). However, not all of the costs of upgrading the M113s are incurred under the Major Upgrade Contract. The cost of preparing and extending the hulls of the 350 vehicles originally ordered in 2002 is met by Army sustainment funding under another contract with the same contractor (the Commercial Support Program (CSP) Contract).⁸ The personnel and operating costs of the upgraded fleet and the costs of staffing and operating the Defence Materiel Organisation (DMO) project office also do not form part of the project budget. The estimated whole-of-life cost for the M113 fleet from 2002–03 to 2025–26, including both the

⁴ The details of the changes in scope that occurred between 1992 and 2002, and the reasons put forward for them, are examined in detail in ANAO Report. No.3 2005-06, *Management of the M113 Armoured Personnel Carrier Upgrade Project*.

⁵ Tenix Defence was also the Prime Contractor engaged to undertake work during the 1990s in connection with the minimum upgrade project for the M113s.

⁶ Tenix Defence is referred to as the original Prime Contractor in this report and BAE Systems is referred to as the Prime Contractor.

⁷ This estimate included all upgrade costs, three years of spares and contingency.

⁸ Tenix Defence was also the original Prime Contractor for the CSP Contract which BAE Systems took over with its June 2008 purchase of that company.

capital costs of upgrading the M113s and the estimated personnel and operating costs of the upgraded fleet over its life, is some \$1.6 billion.⁹

5. The first 16 upgraded vehicles were delivered to Army late in 2007 and, over four years later, a total of 356 upgraded vehicles had been accepted by Defence. The upgraded M113s are the core capability of Army's two mechanised infantry battalions, 5 RAR and 7 RAR, in 1 Brigade. 1 Brigade has received over half of the upgraded vehicles delivered thus far, with the remainder either allocated to training or held in storage.¹⁰ The remaining un-upgraded M113s were progressively withdrawn from service from 2006.

6. The Australian National Audit Office (ANAO) previously examined the progress of Defence and the Defence Materiel Organisation (DMO) in delivering this project in Audit Reports No.3 2005–06 *Management of the M113 Armoured Personnel Carrier Upgrade Project*, and No.27 2008–09 *Management of the Armoured Personnel Carrier Upgrade Project*.

7. Defence's overall response to the 2008–09 audit included the following statement:

The M113 Armoured Personnel Carrier vehicle fleet is undergoing a major upgrade under Project Land 106 which will realise a significant capability improvement over its current design. The Defence Materiel Organisation is charged with managing the \$850 million Project and will deliver 350 upgraded M113 vehicles by December 2010 and [an] additional 81 upgraded vehicles under the Enhanced Land Force initiative by 2011.

8. In undertaking this third audit of the project, the ANAO sought not only to examine Defence's progress in delivering the upgraded M113s into service, but also to examine the capability the vehicles have thus far provided to Army.

9. Defence defines capability as the:

⁹ In the case of the upgraded M113 fleet, the personnel and operating costs estimate includes the costs of operating and maintaining the un-upgraded fleet until the final vehicles were withdrawn in 2010, and the upgraded fleet, from 2002–03 until the upgraded vehicles are withdrawn from service commencing in 2025–26. In addition, it includes the cost of items such as vehicle fuel, ammunition, spare parts, maintenance services and supply services, as well as the cost of decommissioning the vehicles at the end of their life.

¹⁰ As at March 2012, 356 vehicles were delivered to Defence. Of these, 252 had been delivered to 1 Brigade, 24 to the School of Armour and 12 to other units. The remainder are in storage awaiting delivery to units.

capacity or ability to achieve an operational effect. An operational effect may be defined or described in terms of the nature of the effect and of how, when, where and for how long it is produced.¹¹

10. Achieving capability can be complex, and requires more than purchasing equipment. The development of capability involves effectively combining the multiple personnel, equipment and support system inputs required, which Defence has codified in the Fundamental Inputs to Capability (FIC—see Table 5.1 and Appendix 1).

11. In the case of the upgraded M113s, these fundamental inputs include the vehicles, the systems and arrangements for training personnel and for administering support equipment, parts and spares and conducting maintenance, as well as those required for overseeing and planning operations and exercises. Achieving capability with the upgraded M113s also requires battle doctrine and plans to be developed, crews to be trained and exercised with the vehicles (preferably in concert with tanks) to test doctrine and plans, for performance to be evaluated and lessons learned, and for the logistics chain, including repairs and spares, to be effectively in place.

Audit approach

12. The objective of the audit was to assess the progress of the M113 Upgrade Project—LAND 106,¹² including progress in the development of operational capability resulting from the introduction of the upgraded vehicles into service. The high-level audit criteria used to assess the project's progress and Defence's effectiveness in administering the M113 Upgrade Project were:

- the degree to which the schedule for the production and delivery of upgraded M113 vehicles to Defence had been recovered in accordance with Defence's response to the 2008–09 audit report and contractual requirements, as negotiated over the life of the contract;
- Defence's measurement and allocation of the total cost of the upgrade project; and
- the development of capability arising from the upgrade project.

¹¹ Department of Defence, *Defence Capability Development Handbook*, Canberra, August 2011, p. 2.

¹² 'LAND 106' is Defence's project code for the M113 upgrade project.

13. ANAO commenced this audit of the major upgrade project in November 2010, shortly before the last of the original 350 vehicles were due to be delivered under the contract schedule both as originally framed in 2002, and as in place at the time of the 2008–09 audit. Audit fieldwork was conducted during the period November 2010 to October 2011. The audit was conducted in accordance with ANAO auditing standards at a cost to the ANAO of \$625 000.

Overall conclusion

14. The M113 upgrade has, in one form or another, been underway since 1992. In its most recent form, the M113 major upgrade project (also known as Project LAND 106) commenced in July 2002 and involves extending ageing M113 hulls and fitting them with new or refurbished components and equipment. For an investment totalling more than \$1 billion, the ADF expects to receive 431 upgraded M113s as an interim capability to carry it through to 2025 and the projected replacement of its armoured vehicles as part of Project LAND 400.¹³

15. This third audit of the M113 upgrade identified that the project continued to suffer from various technical, administrative and contractual problems following the November 2007 global settlement between Defence and the original Prime Contractor resulting in additional schedule delay. Following a further contract renegotiation in 2011, the majority of vehicles have now been delivered with Defence confident that the remaining vehicles will be delivered by late 2012 as per the revised contract. However:

- the project has suffered significant production delays over its life;
- deficiencies in the project's original contract, in particular the failure to properly specify payloads, meant that technical problems with the vehicles' design and production could not be effectively managed under its provisions;
- overall Defence's cost and schedule management has not been effective, and Defence has been slow to respond to continuing project delays;
- a further contract renegotiation was required in 2011 to address claims by both Defence and the Prime Contractor. It resulted in DMO making

¹³ The vehicles were originally expected to be withdrawn from service in 2020. In March 2012, Defence informed the ANAO that the vehicles are now planned to be progressively withdrawn from service from 2025 with the last of the vehicles expected to leave service around 2030.

financial and schedule concessions in order to maintain production rates and rectify contractual deficiencies. However, since this renegotiation, production has been in accordance with the revised schedule;

- senior decision-makers within Defence and government have not always been kept informed of the project's status in a timely and accurate fashion affecting their capacity to make informed decisions in relation to the project; and
- the upgraded M113 does represent an improvement on the older, unextended vehicle. However, a vehicle that was considered fit-for-purpose when the minor upgrade was first proposed 20 years ago now lags behind armoured infantry vehicles in use with other armed forces, and is vulnerable in many current threat environments, leaving Defence with an acknowledged capability gap.

Production delays

16. ANAO's two previous audits of this project, in 2005–06 and 2008–09, each identified delays in development and construction evident from early in the M113 upgrade project that have not been recovered and have continued.¹⁴ The upgraded vehicles were originally expected to progressively enter into service from 2006, with the final vehicle of the 350 originally ordered due to be delivered by the end of 2010. However, in the event, the first production vehicles were not accepted by Defence until November 2007 and by December 2010 only 194 vehicles had been accepted.¹⁵

¹⁴ Audit Reports No.3 2005–06 *Management of the M113 Armoured Personnel Carrier Upgrade Project* and No.27 2008–09 *Management of the Armoured Personnel Carrier Upgrade Project*.

¹⁵ By August 2009, the total number of vehicles contracted to be delivered by December 2010 had been reduced to 329 vehicles. This was a result of the decision to extend the 21 Armoured Mortar(AM) variant vehicles (see paragraph 52). The additional work required as a result of this decision led Defence and the Prime Contractor to agree a contract amendment that pushed the scheduled delivery date of these vehicles past the December 2010 deadline.

17. The delays led to major contract renegotiations between Defence and the original Prime Contractor in 2007¹⁶ and again in 2011 with the current Prime Contractor. The intended outcome of the 2007 global settlement negotiations was to catch-up production, with the original Prime Contractor agreeing to a compressed schedule that still required delivery of all 350 vehicles by December 2010 and Defence agreeing to an incentive payment of \$2.716 million if the December 2010 deadline was met.¹⁷

18. However, at no time between November 2007 and December 2010 was production on track to meet this schedule. This was so, notwithstanding the original Prime Contractor, in efforts to recover the schedule, having opened at its cost additional production facilities in Williamstown, Victoria and Wingfield, South Australia in late 2008.¹⁸

19. Between the 2007 and 2011 contract renegotiations, two major scope changes had also impacted the contract schedule:

- As noted in paragraph 3, in October 2008 the Government approved a proposal to purchase an additional 81 upgraded M113 APCs. The resulting contract amendment pushed out the due date for delivery of the final vehicle under the Major Upgrade Contract from December 2010 to November 2011, albeit with the original 350 vehicles still contracted to be delivered by December 2010; and
- In August 2009 the Government approved a proposal to extend the 21 Armoured Mortar variant vehicles.¹⁹ The additional work required as a result of this decision led Defence and the Prime Contractor to agree a contract amendment that pushed the scheduled delivery date of these vehicles past the December 2010 deadline, reducing the total number of

¹⁶ The 2005–06 audit reported that the upgraded M113 was originally expected to progressively enter service between 2006 and late 2010 but that there was doubt as to whether the upgraded vehicles would meet this in-service date. At the time, the original Prime Contractor was also commencing production of vehicles at its own risk before they had passed formal testing by Defence. The audit report noted that ANAO considered this approach involved a high level of risk for the delivery of Army capability and that, notwithstanding the Prime Contractor's liability for this risk, it would require close management by both the Prime Contractor and Defence. Audit Report No.3 2005–06 *Management of the M113 Armoured Personnel Carrier Upgrade Project* p.14.

¹⁷ The incentive payment of \$2.716 million was an amount equivalent to the liquidated damages that had been received by Defence as 'work in kind' under the 2007 global settlement.

¹⁸ The Prime Contractor's intention to open the additional facilities in Williamstown and Wingfield was announced as part of the Government's decision in October 2008 to purchase an additional 81 APCs.

¹⁹ See paragraph 52.

vehicles then contracted to be delivered by December 2010 from 350 to 329. The delivery date for the final vehicle of the total of 431 on order also moved out from November 2011 to April 2012.

20. Given the continuing production delays, further negotiations were subsequently required during 2011 to settle a range of claims and counter-claims between Defence and the Prime Contractor. The latest round of contract negotiations culminated in the parties signing a deed of agreement and an amendment to the Major Upgrade Contract in August 2011.²⁰ Under these arrangements, Defence accepted a revised schedule that extends the contractual delivery date of the final vehicle from April 2012 to December 2012.

21. Root causes of the delays can be traced to the earliest days of the project, and in particular to shortcomings in Defence's approach to key engineering and contracting issues. Defence did not always act as an informed purchaser of the engineering and technical services necessary to successfully deliver the vehicles and, as a consequence, the engineering risks apparent early in the project's life were not managed effectively.

22. Key engineering risks included the adoption of a new construction technique that relied for success on unfounded assumptions of the quality and consistency of the ageing M113 hulls that were to be upgraded.²¹ Further, insufficient attention was paid to proving the hull extension production process. This delayed the achievement of a fully effective vehicle construction and assembly process, which was not achieved until late 2010, four years later than originally anticipated and over eight years after the commencement of the current major upgrade project.

²⁰ Contract Change Proposal (CCP) 205. Defence informed ANAO in March 2012 that: 'the main reason for CCP 205 was to provide incentive payments to ensure the [*Prime Contractor's*] additional production facilities were not closed early to reduce the [*Prime Contractor's*] costs. This removed the threat of further schedule delay that could have moved production out by another 12 to 18 months. This was a prudent risk reduction strategy initiated by DMO'.

²¹ The 2008–09 audit reported that meeting the compressed delivery schedule agreed in the 2007 global settlement depended on a smooth flow of hulls and vehicles through the Defence-owned facilities at Bandiana operated by the Prime Contractor. However, during a visit to Bandiana in August 2008, ANAO observed a backlog of work, indicating that schedule risks previously identified by Defence had been realised. The backlog was caused chiefly by delays in extending the hulls. This was proving more complex than anticipated and was taking longer than expected.

Audit Report No.27 2008–09 *Management of the Armoured Personnel Carrier Upgrade Project* p.19.

The report also outlined Defence's investigation of a different hull extension process from that finally adopted. See pp. 69 to 72.

Impact of deficiencies in the original contract

23. Deficiencies in the Major Upgrade Contract meant that technical problems with the vehicles' design and production could not be effectively managed under its provisions. Contrary to the advice tendered to government when the major upgrade was initially approved, critical milestones were not effectively incorporated into the contract, which also failed to properly specify vehicle payloads, prioritise vehicle technical specifications in order of necessity and desirability, or establish clear terms for liquidated damages.²² Over the life of the contract, Defence has sought to correct these deficiencies through various contract amendments, most recently in August 2011.

24. However, these deficiencies have reduced Defence's capacity to effectively manage project risks through the contract, while simultaneously contributing to the numerous extensions of scope that have been a feature of the project. In particular, the failure to properly specify payloads in the contract led to initial vehicle production designs that compromised payload capacity as a means to remain within the gross vehicle weight limit of the vehicles, particularly for variants that were not originally planned to be built on an extended hull. To address this issue and achieve appropriate vehicle designs, Defence found it necessary to seek approval for successive changes to scope so that now all seven variants are to be extended, rather than extending only three variants as envisaged in 2002 when government originally approved the major upgrade.

Cost and schedule management

25. Overall, Defence's cost and schedule management of the M113 upgrade has not been effective. Management and reporting has focused on the Major Upgrade Contract costs rather than total costs,²³ and there have been significant, unanticipated increases in the estimated life cycle costs.²⁴ In

²² ANAO Audit Report No.27 2008-09 *Management of the M113 Armoured Personnel Carrier Upgrade Project*, pp. 35, 53-54, 65-69, 80-81, 84 and 88.

²³ As indicated in paragraph 4, the costs of preparing and extending the hulls of the 350 vehicles originally ordered in 2002 are not funded under the Major Upgrade Contract but are rather funded by Army sustainment funding under another contract with the same contractor (the Commercial Support Program (CSP) Contract).

²⁴ In 2001, when seeking government approval for the project, Defence advised that the impact on personnel and operating costs of this project would be cost-neutral, on the basis that the larger M113 fleet would be withdrawn and replaced with a smaller fleet of upgraded vehicles. As discussed at paragraph 3.11 this has not proved to be the case and the upgraded fleet will incur substantial additional personnel and operating costs over its planned life to 2025.

addition, higher than anticipated costs for work to prepare and extend M113 hulls prior to entry to the major upgrade assembly line, together with delays in finalising the designs of the variants, assembly capacity limitations, and the re-work requirements for completed vehicles, highlight that the project's systems engineering process has also been underdeveloped.

26. Although aware that the Prime Contractor was significantly behind schedule, Defence was slow to respond to the continuing delays in delivering vehicles following the 2007 global settlement. Expenditure and production data provided by the Prime Contractor, and paid for under the Major Upgrade Contract, was not appropriately analysed by Defence. ANAO analysis of this data for the period October 2007 to April 2011 shows that while schedule slippage was particularly evident from January 2009, project expenditure continued as forecast. This can be attributed, in part, to: bringing forward the construction of the 81 additional, more expensive ELF M113s ordered by Defence in October 2008; and the purchase of costly long lead-time components in advance of need.²⁵

2011 contract renegotiation

27. As discussed in paragraph 20, the delays led to another contract renegotiation to address claims by both Defence and the Prime Contractor that was concluded in August 2011. While Defence initially considered it would be in a strong position to refute the Prime Contractor's claims, closer examination of the contract and previous actions of both parties soon led Defence to instead reach agreement with the Prime Contractor that the issues were 'complex and multi-faceted and that responsibility for delay is shared between the Commonwealth and [*the Prime Contractor*]'.²⁶ In response to the proposed audit report, Defence informed the ANAO that it had concluded that, to resolve the situation and get the vehicles as soon as possible for Army: 'a 'commercial' approach would provide a better result than a 'contractual' approach'.

²⁵ As noted in paragraph 3, the Government approved the acquisition of an additional 81 upgraded APCs in October 2008 at a cost of \$222.1 million as part of the ELF initiative. This approval was on the basis that the extra vehicles would be produced after the original 350 vehicles ordered in 2002.

²⁶ Negotiation Deed of Agreement between Defence and the Prime Contractor, August 2011.

28. The outcomes of these negotiations included:

- the withdrawal by the Prime Contractor of \$5 million in postponement claims;²⁷
- agreement by Defence not to exercise contractual rights to seek liquidated damages of approximately \$1 million for late delivery of vehicles;
- the agreement between the parties of a 9 December 2012 final delivery date for all vehicles; and
- incorporation into the contract of provisions providing the potential for incentive payments totalling \$2.8 million to be made to the Prime Contractor if certain production targets are met over the period between August 2011 and October 2012, including bringing forward the final vehicle delivery to 31 October 2012.²⁸

29. Defence further informed ANAO in March 2012 that the key purpose of these incentive payments was to ensure the Prime Contractor's additional production facilities were not closed early to reduce the Prime Contractor's costs, which would have resulted in further schedule delay.

30. Since the August 2011 contract renegotiation, production has been on schedule. Defence informed ANAO in March 2012 that the Prime Contractor's subsequent production performance was sufficient to receive the first and second quarterly incentive payments available under the contract as amended, and that production in the third quarter has been sufficient to receive the third quarterly incentive payment. Defence considers that the Prime Contractor is currently on course to deliver all 431 vehicles by October 2012.

²⁷ The Prime Contractor's postponement claims covered four key issues: laminar cracking on M113 hulls (see paragraph 64); missing or broken lifting eyes on the hulls (see paragraph 69); delays caused by the AM extension; and facility failures at the Bandiana production facility, which is owned by Defence. These facility failures included: insufficient compressed air supply, water contamination in compressed air supplies, insufficient power for additional welding bays, breakdown of grit blasting equipment and cranes, and the breakdown of the machinery used for extending the hulls.

²⁸ The total incentives of \$2.8 million are potentially available to the Prime Contractor under the amendment to the Major Upgrade Contract. These comprise four quarterly incentive payments of \$400 000 each for meeting prescribed production targets and a final acceptance incentive of \$1.2 million if all 431 vehicles are delivered by 31 October 2012. See Table 4.1 for further details of the timing and nature of the targets and incentives.

Advice to government and senior decision-makers

31. Over the life of the project, senior decision-makers within Defence and government have not always been kept informed of the project's status in a timely and accurate fashion. Ongoing delays prompted the Government to place the M113 upgrade on its Projects of Concern list in December 2007. It was removed from that list in May 2008 on the basis of Defence advice that included incorrect information regarding production rates, and assurances that schedule delay would be recovered. Subsequent advice to government in support of the 2008 proposal to acquire a further 81 upgraded APCs and the proposal to extend the AM variant²⁹ also contained incorrect and unrealistic advice relating to schedule production rates and projections. There have been several such instances of incorrect and/or unrealistic reporting on project status, and issues affecting this, over the life of this project.³⁰

32. Notwithstanding the schedule slippage experienced by the project, and the ongoing engineering difficulties with the vehicles, Defence purchased an additional 81 vehicles at a significantly increased unit cost, and provided the Prime Contractor with a fourth prepayment of \$16.2 million (October 2001 base date dollars) in 2008.³¹ The 2008 payment raised the total quantum of prepayments to the Prime Contractor in respect to upgrading Defence's M113s to over \$100 million (approximately 20 per cent of the Major Upgrade Contract value). This prepayment was made despite there being no ramp-up costs for the Prime Contractor, as the additional vehicles were to be upgraded using an established production line where APCs are the most produced variant. Providing a prepayment to an established production facility was at odds with normal commercial practice and the guidance contained in Defence's own procurement policy.

33. When seeking government approval for the purchase of the 81 additional upgraded vehicles, Defence advised government that the unit cost

²⁹ In August 2009, the Government approved the extension of the last unextended variant, the Armoured Mortar (AM), at a cost of \$17.1 million, and the resulting contract amendment pushed the completion date for the last vehicle out to April 2012.

³⁰ See Table 4.2.

³¹ An initial prepayment (or mobilisation payment) of \$4.21 million was made to the Prime Contractor in May 1997 in connection with the then contract for a minor upgrade of the M113 fleet. Defence advised that this prepayment had been recovered in full by November 2007. Three prepayments have been made under the Major Upgrade Contract (\$40 million in 2002, \$40 million in 2007, and \$16.2 million in 2008). Each of these later payments were in October 2001 base date dollars and are to be amortised across the remaining life of the contract from the point they were made.

of each of these vehicles was comparable to that of the APCs originally contracted in 2002. However, the total cost for upgrading the 81 additional vehicles is approximately \$11.4 million (2001 base date dollars) more than the cost of upgrading to the same standard 81 APCs under the terms applying to the original 350 vehicles, despite being produced on the same production line.

Capability

34. In addition to engineering and contracting issues, capability issues have arisen in the course of the project. The delivery of new capability requires more than the delivery of a new or upgraded platform. The effective operation of new capability also relies on combining the multiple personnel, equipment and support system inputs, which Defence identifies as its Fundamental Inputs to Capability (FIC). The development and delivery of the upgraded M113 vehicles has occurred in isolation from the development of some of these FIC elements.³²

35. As a consequence, the ability to deploy and effectively use the upgraded M113s is constrained by limitations in several key inputs to capability, including less than optimal communication systems, and restrictions on transporting the vehicles by means of Defence's existing land and air assets. These issues have only been identified toward the end of the upgrade project. Remedying them relies on other allied Defence projects, which in some cases will take some years, and potentially will affect the M113 fleet through most of its remaining life.

36. As Army's front-line mechanised infantry platform, the M113's primary function is to allow Army to effectively mount close-combat operations in a variety of threat environments, including by protecting the lives of the soldiers who rely on the vehicles as one of their main tools of battle. Over the course of the M113 upgrade project, Defence and Army have confirmed to government the continuing requirement for these vehicles and Defence informed government in 2008 that an additional 81 upgraded vehicles were required in addition to the 350 vehicles then on order. However, since the commencement of the major upgrade in 2002, the threat environment for Army's infantry forces has changed significantly, both in terms of the methods

³² ANAO notes that the upgraded M113 is not an isolated case. In this context, another recent instance where coordination of essential inputs to capability has been less than optimal was the sub-standard maintenance of the Navy's heavy-lift ships. The logistic underpinnings of materiel systems are integral to achieving capability and require attention throughout the capability life cycle.

of current enemies and potential threats, and the military hardware they possess.

37. As a consequence of the delays in the design and production of the upgraded vehicles, this project is now delivering an increasingly dated class of vehicle. The Acting Chief of Army, as Capability Manager for the of the upgraded M113 fleet, informed ANAO in December 2011 that the upgraded M113 fleet of vehicles 'is a significant improvement to the obsolete [*un-upgraded fleet of vehicles*] and affords greater flexibility in mechanised force structure for a range of contingency and future tasks until the comprehensive mounted close combat capability that will be provided by Land 400 solutions'.³³ However, he also identified that a capability gap currently exists across all mechanised close-combat operations:

It is important to note that while the [*upgraded M113*] is a capable combat vehicle, it does have constraints and limitations through design and capacity as it is based on the [*original M113*] hull. This factor limits its potential in comparison to higher order platforms including current generation [*infantry fighting vehicles*]. This fact essentially provides a capability gap for the conduct of close combat across the spectrum of conflict until the introduction into service of the Land Combat Vehicle System (Land 400).³⁴

38. In response to the draft audit report, in April 2012 the Chief of Army provided clarifying comments on the use and meaning of the term 'capability gap':

The term refers to the difference between a stated capability requirement and Army's ability to fulfil that requirement ...

While the existing level of protection of the [*upgraded M113*] is high, analysis shows that the vehicle's major limitation will be its ability to support close combat operations against an enemy which is capable of employing a broad variety of conventional and unconventional methods of attack.³⁵

39. The Chief of Army also noted that:

as the Capability Manager ... I am satisfied that the [*upgraded M113*] provides a significantly enhanced capability to Army and that it is a potent and capable

³³ Minute to ANAO from the Acting Chief of Army, 19 December 2011.

³⁴ The Acting Chief of Army's full response appears in Appendix 3 of this report.

³⁵ The Chief of Army's full response appears in Appendix 4 of this report.

platform. I am also satisfied that the delivery of [*the upgrade project*] satisfies the original requirement specified by the Capability Manager.

40. The upgraded M113 does represent an improvement on the older, unextended vehicle. However, a vehicle that was considered fit-for-purpose when the minor upgrade was first proposed 20 years ago now lags behind other armoured infantry vehicles, and is vulnerable in many current threat environments. The major upgrade of the fleet, first announced in the 2000 Defence White paper, was only intended as ‘an interim or bridging capability’ until a replacement family of vehicles could be procured.³⁶ However, LAND 400, which will include a replacement for the M113, does not currently plan to deliver its first operationally ready units until 2025–26 at the earliest,³⁷ leaving Army a vehicle with significant limitations that is currently due to be withdrawn from service commencing around 2025.

41. At several stages during the project, Defence has reaffirmed the need to continue with the procurement of the upgraded M113s. In March 2007, Defence advised the then Minister that ‘termination [*of the major upgrade project*] is not being considered at this stage owing to the importance of this capability and the cost and schedule of viable alternatives’.³⁸ Defence further justified to government in 2008 the purchase of the 81 additional upgraded M113s on the basis that:

- the upgraded M113s provided superior protection in comparison to the Bushmaster and ASLAV;
- the vehicles could be deployed to Iraq and Afghanistan with relatively low-cost upgrades; and
- the vehicles could withstand heavy machine-gun fire.

42. As late as March 2009, Defence’s assessment was that there were no viable alternatives to the upgraded M113s, and that delays in the development of the upgraded M113 capability were manageable. However, a number of key capability aspirations sought by Defence for the upgraded M113 capability

³⁶ See ANAO Audit Report No.27 2008–09 *Management of the M113 Armoured Personnel Carrier Upgrade Project*, p. 27.

³⁷ At the time of the 2008–09 audit, Defence intended LAND 400 to begin replacing M113s and ASLAVs from around 2015.

³⁸ See ANAO Audit Report No.27 2008–09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, p.87.

have to date either been only partially achieved, are yet to be achieved or have proven unachievable (see Table 5.4).

43. It is an inherent risk in Defence major capital acquisitions that the often substantial elapsed time between approval and completion may lead to a gap opening up between the delivered capability and the requirements of the contemporary threat environment. In addition the long time-frames, of themselves, present challenges in coordinating the delivery of required FIC elements to generate the planned level of capability and project delays complicate this further. These circumstances require active management by Defence to successfully deliver these major projects.

44. In the case of the M113 upgrade project, this inherent risk has been exacerbated by the project's history. The current Major Upgrade Contract was let without an open tender process and arose originally from an unsolicited proposal from the original Prime Contractor, who was at the time contracted both to undertake a minimal upgrade of M113 fleet and the sustainment work for the vehicles under the CSP Contract. The scope of the project has subsequently required extension several times, particularly in terms of extending all seven of the variants and acquiring the additional 81 ELF vehicles. However, during this audit, and the previous two ANAO audits, Defence has not been able to provide appropriate evidence that alternative strategies to deliver the required capability were effectively considered.

45. Even as originally planned, the M113 major upgrade project was expected to span some 8 years. In the event, some 10 years are currently expected to elapse before it is completed, albeit this includes several changes to the project's scope including the acquisition of an additional 81 upgraded vehicles. The extended time-frame covered by the project has also exacerbated the impact of initial technical and contractual deficiencies. However, the full implications of these deficiencies have not always been communicated to senior decision-makers inside Defence and government in a timely way.

46. Following the 2007 global settlement, improved production rates were not achieved by the Prime Contractor until November 2010, but these have subsequently been sustained. As discussed in paragraph 30, since the August 2011 production has been on schedule and Defence considers that the Prime Contractor is currently on course to deliver all 431 vehicles by October 2012.

47. While Defence has demonstrated persistence in the face of numerous difficulties, the centrality and potential implications of the engineering, contracting and capability issues that have arisen over the life of this project

required the informed engagement of leadership at the highest level. However, accurate information about the status of the project and the full implications of key issues was not always communicated to senior Defence decision-makers and the Government, ultimately limiting their capacity to address key project risks and the emergence of a capability gap over time. Maintaining effective strategies and processes to avoid such a state of affairs is a matter for leadership, and it is essential that Defence's current reform efforts reinforce the importance of the strategic assessment of projects at key milestones, based on the best information available.

48. The ANAO has made one recommendation aimed at improving the coordination of inputs to capability when developing or upgrading combat platforms.

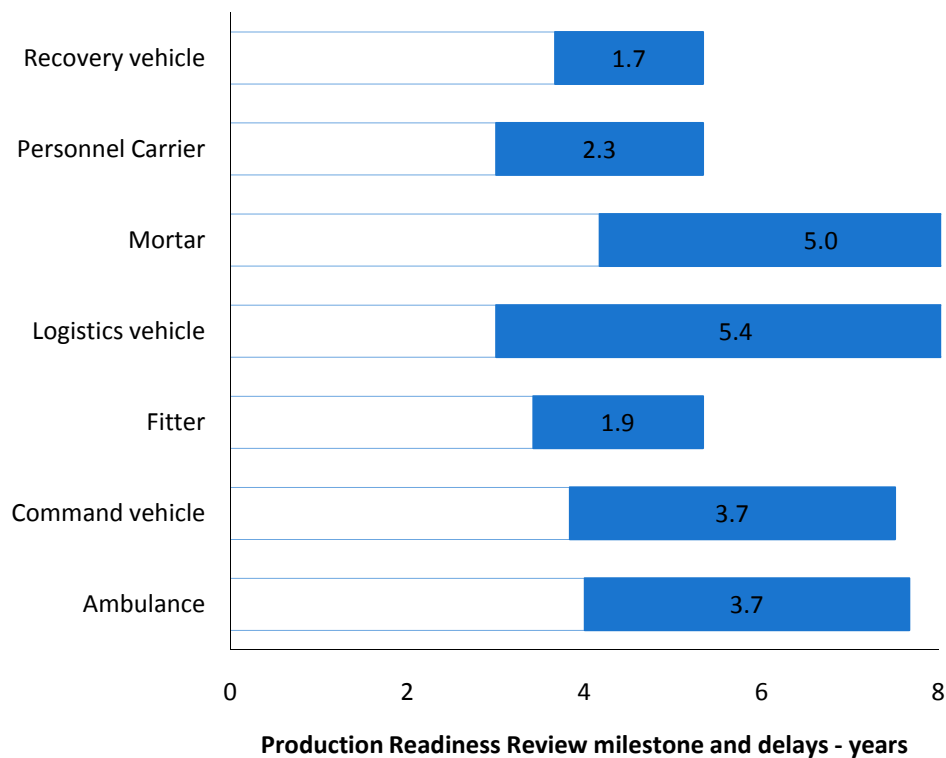
Key findings by chapter

Chapter 2 – Managing vehicle design and project scope

49. The design management framework for upgrading the M113 fleet is based on a series of critical design reviews and audits, culminating in a Production Readiness Review (PRR), which provides assurance that each variant is ready to enter full-scale production. As shown in Figure S 1, all variants in the M113 fleet suffered delays in completing their respective PRRs compared to the original contract schedule, particularly the ALV and AM variants.

Figure S 1

Delays in achieving the Production Readiness Review milestone against the original 2002 schedule



Source: ANAO analysis of Defence data.

50. This situation contrasts with DMO’s advice to the Parliamentary Secretary for Defence Procurement in May 2008 that, in its view, the major technical risks in the development of the M113 fleet were retired when the APC variant successfully completed its PRR in November 2007.³⁹ Given the level of commonality in the other variants, DMO considered that the testing and development of the remaining variants was lower risk. The delays in the successful completion of PRRs, combined with slow production rates, have limited the number and range of variants delivered to Army thus far.

³⁹ This advice was provided in connection with DMO’s proposal that the Land 106 – M113 Upgrade Project be removed from the Government’s Projects of Concern list.

51. The prolonged development and design processes for the M113 variants resulted, in part, from the underestimation of the engineering requirements for the fleet upgrade at the outset of the major upgrade. This has been caused by an underdeveloped approach to the project's systems engineering process. This is reflected in the unexpected findings that four of the seven variants (the ARVL, AA, AC and AM), if upgraded as planned based on their original unextended hulls, would exceed their Recommended Gross Vehicle Mass when loaded. From the outset the Major Upgrade Project contract provided for the extension of the hulls of the other three variants (the APC, AF and ALV),⁴⁰ but, in the event, the hulls of all seven variants required extension to accommodate the weight of the upgrade. Defence's contractual options for dealing with this issue were limited by defects in the Major Upgrade Contract, which included the failure to specify vehicle payload requirements in the original 2002 Major Upgrade Contract.

52. The scope of the upgrade project has changed significantly since the Government approved the major upgrade in June 2002. In addition to the progressive decisions to extend all seven of the M113 variants, rather than the three originally intended, 81 additional upgraded APCs were contracted for in 2008. The most recent scope change—the August 2009 decision to extend the AM variant—was based on various capability and cost benefits, however the primary cost benefit—the potential to replace the 81mm mortar—was predicated on a possible future decision for which no plans currently exist.⁴¹

53. Taken individually, each scope change has appeared moderate and manageable. If viewed in aggregate, however, their impact amounts to a major change in the overall design of the fleet, generating significant delays and highlighting the importance of maintaining strong overall design

⁴⁰ The hulls of 259 of the 350 M113s ordered in 2002 were originally planned to be extended comprising 171 APCs, 38 AFs and 50 ALVs.

⁴¹ In its business case to government, Defence identified several benefits from extending the AM variant. These included improving the firing position of the mortar, savings in long-term maintenance, and facilitating future upgrades of communication systems and mortars.

management.⁴² The 2008–09 ANAO report recommended that Defence set suitable threshold criteria for determining scope changes to allow decisions to be made on scope changes, especially where it involves changes in capability.⁴³ Defence's updated policy and guidance notes that scope changes may affect the capability originally sought, and highlights the need to engage with bodies such as Capability Development Group and the Capability Manager if capability changes affect the original project approval. However, this does not extend to documenting suitable threshold criteria for determining how significant changes in capability—including the timing of delivery and extent of capability to be delivered by a project—should be identified and considered for approval, irrespective of financial impact. In this context, Defence's documented criteria remains focussed on financial thresholds, and Defence has some way to go before it has addressed the recommendation made by ANAO in March 2009.

54. As the responsibility for both design acceptance and for operational test and evaluation of Army materiel is vested in DMO, the degree and level of involvement of the Chief of Army as the Capability Manager in the agreement and management of the scope changes is not clear. There would be merit in Defence considering a greater separation of roles to provide a more transparent distinction between the organisation charged with developing major land systems, and responsibility for acceptance of the design, including major scope changes, which would benefit from the direct involvement of the Capability Manager. The current lack of separation between design acceptance and operational test and evaluation that exists for Army is at odds with the important principle that the organisation conducting operational test and evaluation should be independent from the equipment acquisition organisation.

⁴² In seeking approval for extending the AM, Defence advised Government that the technical and cost risk was 'low'. However, because of the age and wear and tear on the AMs, the hulls require additional repair work, the cost of which is borne under the uncapped Commercial Support Program (CSP) Contract. The schedule risk presented by extending the AM was assessed by Defence as 'low – medium', lower than the 'medium' risk of not extending the mortar. This advice to government was based on a production rate that Defence had acknowledged six months earlier was unachievable. In addition, the final contracted delivery date was extended at that time from December 2011 to April 2012, and the vehicle delivery schedule was rearranged to provide the AM variants last, despite Army's preference to have the vehicles as early as possible. Defence informed ANAO that the decision to produce the AMs last was based on the increased work involved in their production.

⁴³ Audit Report No. 27 2008-09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, Recommendation No.1 and paragraphs 2.28 to 2.30, pp. 56-57.

Chapter 3 – Monitoring cost and schedule

Cost

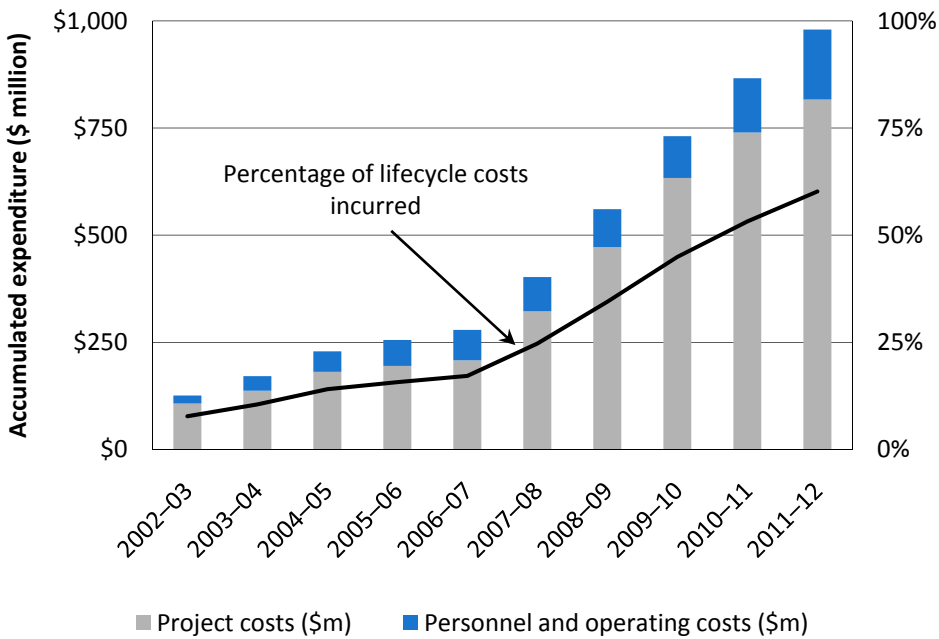
55. As at 30 June 2011, total expenditure on upgrading the M113s stood at \$739 million, along with accumulated personnel and operating costs⁴⁴ estimated at \$127 million. As shown in Figure S 2, by July 2012 the accumulated expenditure on upgrading and operating the M113 fleet will approach \$1 billion, or 60 per cent of the total estimated whole-of-life cost of more than \$1.6 billion. Personnel and operating costs, including the costs of running the DMO Project Office, are not counted as part of the project's cost. Defence estimates that personnel and operating costs will amount to \$769 million over the life of the upgraded M113 vehicles.⁴⁵

⁴⁴ Personnel and operating costs include the cost of Army personnel to operate and maintain the vehicles, and the materiel sustainment costs such as spare parts and servicing.

⁴⁵ The total estimate is comprised of the costs of maintaining and operating the non-upgraded fleet from 2002–03 until their withdrawal in 2010 and the upgraded fleets from 2002–03 until their planned withdrawal from service in 2025, including items such as vehicle fuel, ammunition, spare parts, maintenance services and supply services, as well as the costs of de-commissioning the vehicles at the end of their life.

Figure S 2

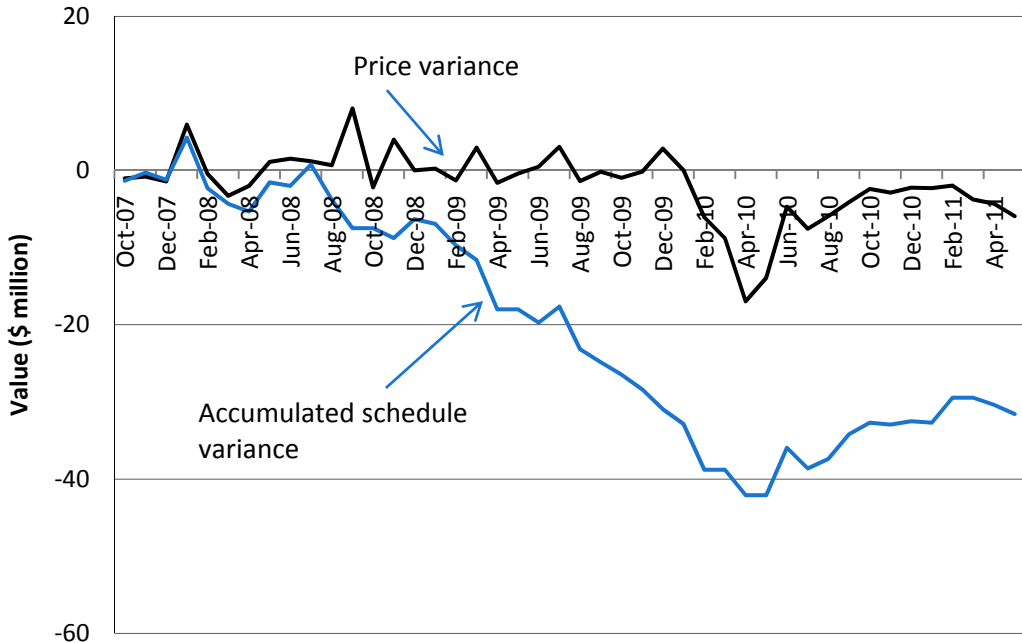
Cumulative expenditure on upgrading and operating the M113 fleet, 2002–03 to 2011–12



Source: ANAO analysis of Defence data.

56. ANAO analysed monthly Cost Schedule Status Reporting (CSSR) reports provided to DMO by the Prime Contractor (see Figure S 3), comparing performance over time to the 2007 global settlement schedule (the schedule in place at the time of the last audit). This analysis indicates that Defence’s monthly expenditure was largely similar to that budgeted. However, from early 2009, actual schedule performance began slipping significantly behind the performance that would otherwise be indicated by the level of expenditure. Accumulated schedule slippage reached a low point in April 2010, with approximately \$42 million of scheduled work not being delivered against the 2007 global settlement schedule.⁴⁶

⁴⁶ The accumulated schedule variance line measures performance against the 2007 global settlement schedule and the schedule advised by Defence at the conclusion of the 2008–09 audit. If schedule variance is measured against subsequent rebaselined contracts, which includes those for the additional 81 vehicles and the extension of the mortar variant, the low point of schedule slippage would be February 2010, with \$30 million of scheduled work not being delivered.

Figure S 3**M113 major upgrade project price and schedule variance trends**

Note: CSSR reporting for the M113 project is based upon 'price' rather than 'cost'. Cost is the direct expense incurred for delivering a work package, while price is the amount the Commonwealth is paying for the work package. Price will include a rate of profit, and price is the basis of the deliverables listed in the Major Upgrade Contract's work breakdown structure.

Work conducted under the CSP is not included in this figure, as it is not performed under the Major Upgrade Contract.

Source: ANAO analysis of Defence documentation.

57. The trend identified in the CSSR data indicates that expenditure has occurred without the achievement of schedule, which may be attributed to a range of factors, including:

- The purchase of costly long lead-time items in advance of need: this has been done over time to avoid underspending budget allocations. ANAO fieldwork in September 2011 found 102 drive systems in stock (with additional drive systems in transit from overseas) worth approximately \$51 million, which was in excess of need at the time.
- Higher contracted unit costs for ELF vehicles: despite Defence's advice to the Minister that ELF APC unit costs were similar to unit costs of APCs under the Major Upgrade Contract, ANAO analysis shows that

cost of the 81 ELF APCs will be approximately \$11.4 million (October 2001 base-date dollars) more than for 81 of the originally contracted APCs out-fitted to the same standard.⁴⁷

58. The contract amendment providing for the purchase of the 81 ELF vehicles included the provision of a \$16.2 million prepayment (October 2001 base date dollars) to the Prime Contractor. Defence agreed to make this prepayment notwithstanding that the vehicles (all APCs) were to be built using an existing, well-established production line, where APCs are the most produced variant, and where no 'significant non-recurring ramp-up costs' are evident. This takes total advance payments over the life of the upgrade of M113s to some \$100.4 million.⁴⁸

Whole-of-life costs

59. At the time of project approval, Defence advised the Government that it estimated that the smaller upgraded M113 fleet would cost no more to run than the older, larger fleet it was replacing. During the 2008–09 audit, the ANAO sought information from Defence on the personnel and operating costs associated with the original M113A1 fleet of some 700 vehicles. However, Defence informed the ANAO that these costs were not recorded. It is not clear therefore what the baseline personnel and operating costs were that Defence used to estimate the likely quantum of these for the upgraded M113 fleet. As Defence has developed better cost estimates, factoring in the actual costs of operating these upgraded vehicles, its estimate of total personnel and operating costs has increased, with the current estimate close to \$800 million (Budget 2010–11 prices) over the planned life of the upgraded vehicles to 2025. Part of the increased cost is due to the increase in size of the upgraded fleet from 350 to 431 in 2008.

Commercial Support Program Contract costs

60. Work on stripping, repairing, extending and painting most of the M113 hulls is conducted under a separate contract, the Commercial Support Program

⁴⁷ Not all of the 171 original APCs in the first tranche of 350 vehicles were to be out-fitted with appliqué armour but all 81 ELF APCs are.

⁴⁸ Comprised of: a \$4.21 million mobilisation payment (December 1996 dollars) made to the Prime Contractor under the previous contract related to the then proposal for a minimum upgrade of the M113s; a \$40 million mobilisation payment (October 2001 base-date dollars) on signature of the Major Upgrade Contract in July 2002; a further \$40 million mobilisation payment (October 2001 base-date dollars) made following the successful completion of the PRR for the APC variant in November 2008; and the \$16.2 million mobilisation payment for the additional ELF vehicles in January 2009.

(CSP) Contract, and not provided for in the major upgrade budget. However, this work is funded from the major upgrade budget in respect of the additional 81 ELF APCs and the 21 AMs as a result of scope changes approved by government. Because of funding pressures in 2010–11 on Army's sustainment budget (which funds M113 work under the CSP Contract), the production of the ELF APCs was brought forward, despite being originally scheduled to be produced last.

61. Defence and the Prime Contractor inspect stripped M113 hulls to determine whether it is feasible to upgrade them, based on both technical and economic viability. The cost of extending the hulls varies from hull to hull. After the first 40 hulls, when the necessary production techniques and systems had been established, the average number of hours worked on each hull has been in the order of 2200, for an average cost of approximately \$96 000, almost double that estimated at the beginning of the production process.⁴⁹ Up to December 2010, M113-associated costs under the CSP Contract were approximately \$32.4 million, which are the latest costs available (based on Defence advice).

Schedule

62. At the time the last ANAO audit of this project was completed in March 2009, Defence was embarking on an ambitious program to recover the production schedule for upgrading the original 350 M113s, which were due by December 2010. In the course of that audit, Defence was not able to provide a contemporaneous analysis of the feasibility of the delivery schedule agreed as part of the 2007 global settlement.⁵⁰ The recovery plan required increased production by the Prime Contractor, and with the decision to purchase an additional 81 APCs in October 2008, included opening additional facilities at Williamstown in Victoria and Wingfield in South Australia, which were to be operated at no additional cost to the Commonwealth.

63. Figure S 4 compares the originally contracted schedule (350 by December 2010) with progress to date, showing that the schedule has not been recovered, and improved production rates have only been achieved since

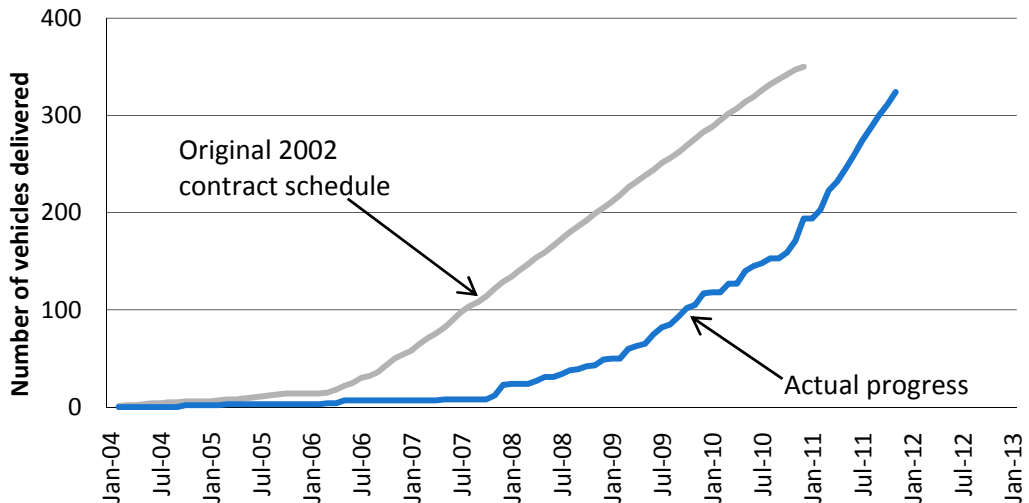
⁴⁹ Some of the increase over time can be attributed to an increase in the cost of materials.

⁵⁰ Audit Report No. 27 2008-09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, p. 98.

November 2010. By December 2010, only 194 of the required 329 vehicles had been accepted.⁵¹

Figure S 4

Originally contracted schedule and actual vehicle delivery, 2004 to December 2011



Note: The first upgraded vehicles produced were Initial Production Vehicles (IPVs or prototypes) required for testing prior to entry into full production, which occurred late in 2007.

Source: ANAO analysis of Defence documentation.

64. A range of factors have impacted on project schedule performance, including:

- delays in the preparation and extension of hulls under the CSP Contract to feed into the major upgrade production line;
- larger than anticipated numbers of vehicles requiring rework following quality assurance inspections, placing pressure on the production facilities at Bandiana, where there is limited room for rework;
- facility failures at the Defence-owned facilities in Bandiana;

⁵¹ The number was reduced from 350 to 329 after the August 2009 decision to extend the 21 AMs.

- hull de-lamination,⁵² resulting in hulls requiring additional preparation work,⁵³
- delays in the technical development of the ALV and AM; and
- shortages of vehicle communication harnesses to be supplied by Defence and required to complete the assembly of the vehicle.

65. However, the improved production rates achieved in November 2010 have been sustained since then. The Prime Contractor is meeting the quarterly production targets set out in the contract as renegotiated in August 2011, and Defence is confident that the Prime Contractor will deliver all 431 vehicles by October 2012.

Chapter 4 – Contract renegotiation and project reporting

66. A key outcome of the global settlement negotiations with the Prime Contractor in late 2007 was the development of a new production schedule that retained December 2010 as the date by which all of the original 350 vehicles were to be delivered.⁵⁴ However, by December 2010, there had been no recovery of schedule as planned under the 2007 global settlement. Only 194 vehicles had been accepted for service by December 2010, of which 140 were APCs; 29 were Armoured Fitters (AFs); 13 were ARVLs; nine were ACVs; and there were two ALV Initial Production Vehicles (IPVs) and one AA IPV. Under the revised schedule that was current as at December 2010, more APCs and AFs should have been delivered by that time, and substantial progress should also have been made with delivery of ACVs and ALVs.

67. These continuing delays in the vehicles' production led to another contract renegotiation. Preliminary discussions between Defence and the Prime Contractor commenced in June 2010—the actual contract negotiations commenced in February 2011 and concluded in August 2011. Initially, DMO

⁵² Aluminium and other metals can develop 'onion skin' fractures, where the metal fractures in layers through its depth. This type of fracturing is commonly called a lamination fracture, in which layers of sound metal are separated by corrosion products and voids.

⁵³ DMO considers that no delay was caused by this issue, as throughout the relevant period sufficient hulls were approved for extension to keep production going. The Prime Contractor informed ANAO in March 2012 that the work required to strip hulls and then determine the delamination created a shortage of hulls for the production line in Bandiana. The repair technique was not subject to mine blast testing, as the project director indicated that the source of the de-lamination is not in areas normally exposed to blast.

⁵⁴ The acquisition of the additional 81 ELF vehicles was subsequently approved in October 2008 and these were to be delivered by December 2011.

was of the view that the delays were the responsibility of the Prime Contractor, and Defence would be entitled to recover liquidated damages. The Prime Contractor counter-claimed for \$5 million in excusable delay claims, on the basis that the condition of the hulls, Defence facilities and equipment were responsible for delays. DMO's rejection of this counter-claim triggered contractual dispute resolution procedures in November 2010.

68. After further review in February 2011, DMO reassessed its negotiation strategy for the following reasons:

- difficulty in documenting specific claims;
- receipt of more development documentation from the Prime Contractor;
- DMO may have already undertaken actions, or provided advice, that would contradict its own negotiation position; and
- the parties had been acting outside of certain contract provisions for a significant period of time, which would potentially undermine DMO's attempts to enforce contractual dispute resolution clauses.

69. The main issues requiring negotiation were delays caused by:

- laminar cracking (which resulted in hulls being set aside until a suitable repair technique could be developed);
- missing/broken lifting eyes (which caused delays in moving hulls through the CSP process);⁵⁵
- development of the AM variant; and
- facility failures at Bandiana.

70. DMO's focus in the negotiations was to develop a new, realistic production schedule,⁵⁶ and to provide contractual certainty over government-furnished materiel and the contractual liquidated damages

⁵⁵ Lifting eyes are steel loop attachments on the front and rear of an M113 that allow the vehicle to be lifted by crane on to transport platforms. Lifting eyes are also used by the Prime Contractor to move hulls through the hull preparation and extension process conducted under the CSP.

⁵⁶ The authorised April 2011 contract negotiation directive noted that:

It is clear that the compressed schedule resulting from global settlement in 2007 was overly aggressive. This was clearly identified as early as 27 March 2009 by the ANAO in Audit Report No. 27 'Management of the M113 Armoured Personnel Carrier Upgrade Project'.

regime. In order to achieve these goals, DMO was willing to provide an incentive payment for the Prime Contractor meeting a revised delivery date, and in return for each party withdrawing its claims regarding the period of delay.

71. In-principle agreement was reached in May 2011, with agreed outcomes subsequently finalised in late August 2011. The negotiation deed of agreement notes that the causes of the issues considered are ‘complex and multi-faceted and that responsibility for delay is shared between the Commonwealth and [*the Prime Contractor*]’.

72. The revised schedule specified that delivery of the final vehicle of the 431 to be upgraded was due on 9 December 2012, some eight months later the schedule agreed following the Minister’s approval in August 2009 of the change in scope to extend the AM variant. The Major Upgrade Contract, as amended in August 2011, now includes a total of \$2.8 million in incentive payments⁵⁷ should the Prime Contractor deliver all vehicles by 31 October 2012. The revised contract also improved the clarity of liquidated damages clauses and Government Furnished Equipment⁵⁸ provisions, and Defence agreed not to seek liquidated damages against the Prime Contractor in respect of delays in delivery of vehicles over the dispute period and the Prime Contractor agreed not to seek its postponement costs claim.

73. As part of the negotiation process, in July 2011, DMO undertook an internal review of the proposed new schedule. The review was generally sceptical of the proposed new schedule, highlighting several risks and noting the lack of disclosure from the Prime Contractor of its detailed schedule. However, it noted that the schedule was achievable, provided that there were suitable contractual arrangements to protect the Commonwealth from further loss from delay.

74. DMO conducted a Gate Review in August 2011 to consider the outcomes of the 2011 negotiations and whether the project warranted a return

⁵⁷ Similar to the amount proposed at the 2007 global settlement for a December 2010 delivery date.

⁵⁸ Government Furnished Equipment is equipment provided by Defence to complete the M113 assembly. It includes items such as communications equipment and weapons systems.

to the Projects of Concern list.⁵⁹ The review noted the new schedule was a low-medium risk, and that ‘the way ahead to complete the project is clear’.

75. The 2011 renegotiation resulted in financial and schedule concessions by Defence, with the Prime Contractor also withdrawing \$5 million in postponement claims that were open to dispute. The circumstances which put DMO in a position where it could not confidently contest the counter-claims made by the Prime Contractor in reaching the August 2011 agreement, can be traced in large part to the 2007 global settlement. By not scrutinising the feasibility of the 2007 global settlement delivery schedule at the time, DMO agreed to an unrealistic production schedule, with delays evident well before renegotiations began in 2010.⁶⁰

76. There does, however, appear to have been benefits in improving the clarity of certain contractual requirements. DMO was also able to ensure that the improved production rates—evident since November 2010—have been sustained since then, including during the negotiation process. Defence informed the ANAO in March 2012 that in undertaking these negotiations:

Defence’s requirement was to get the vehicles as quickly as possible, while keeping the [Prime] Contractor motivated to perform. Accordingly, a commercial ‘win/win’ solution was required, irrespective of the contractual issues—which were subject to interpretation by both parties.

Analysing and reporting on project progress

77. Overall, there has been a lack of detailed analysis of schedule by DMO over the course of the major upgrade project. As noted in paragraph 62, Defence was not able to provide any contemporaneous analysis of the feasibility of the delivery schedule agreed as part of the 2007 global settlement. There has also been a reliance on the Prime Contractor’s reported performance, including projected performance, without sufficient independent verification. It was not until June 2010 that senior-level meetings were held between DMO and the Prime Contractor to deal with production delays—at around the time that accumulated schedule variance reached its lowest point.

⁵⁹ Gate reviews are a DMO assurance process intended to improve project outcomes and ensure DMO is able to provide high quality and reliable advice to Defence and Government regarding the health and outlook of major capital projects.

⁶⁰ During the 2008–09 audit, the ANAO sought evidence from Defence regarding any analysis that it had undertaken of the feasibility of the schedule agreed in the 2007 global settlement. Defence was not able to provide ANAO with any such contemporaneous analysis. In May 2008, during an appearance before Senate Estimates, Defence advised Parliament that ‘This is a high risk production schedule’.

78. Over the life of the project, reporting to senior decision-makers within Defence and government has not always presented an accurate picture of the current and likely future performance of the M113 upgrade project. Part of this has been the practice of only reporting against revised contract due dates without reference to original project intentions. Additionally, there has been a lack of appropriate schedule analysis by DMO throughout the later stages of the project. A lack of detailed understanding of project progress and schedule issues has been an ongoing feature of this project. Project reporting is an important component of management and accountability processes and every effort should have been made to ensure that they provided clear and accurate advice on the extent of delays in the project, and their implications.

79. Advice to government following the 2007 global settlement has frequently contained incorrect and/or unrealistic advice on project progress and projected performance (this advice is analysed in Table 4.2).

Chapter 5 – M113 capability

80. Defence defines capability as ‘the capacity or ability to achieve an operational effect. An operational effect may be defined or described in terms of the nature of the effect and of how, when, where and for how long it is produced’. Capability development within Defence is not based solely on the acquisition of hardware, such as the upgraded M113. Rather, it involves the combination of multiple personnel, equipment and support system inputs.

81. These inputs are set out in Defence’s Fundamental Inputs to Capability (FIC) framework⁶¹ which enables Defence to effectively deploy and sustain its forces. In considering the capability of the upgraded M113, the ANAO examined the four elements of the FIC relevant to the current stage of the vehicle’s production and introduction into service: major systems; facilities; supplies and support.⁶²

82. The major systems component of the FIC for the M113 upgrade project is the M113 vehicle, and its availability is a key issue from a capability perspective. Availability has two broad dimensions in this circumstance — the day-to-day availability of upgraded vehicles for their intended use, and the

⁶¹ See Table 5.1.

⁶² The ANAO focused on these four elements of the FIC on the advice of Defence, at the commencement of the audit, that the other FIC elements would not be fully developed until the delivery of all variants.

broader impact on capability of any failure to deliver upgraded vehicles in the first place.

83. In examining the first dimension, the ANAO analysed vehicle availability data from the School of Armour, currently the most frequent and consistent user of the vehicle.⁶³ Maintenance records classify the vehicles as 'Fully Functional'; 'Restricted Use'; or 'Unserviceable'. Over the three years to December 2010, the proportion of vehicles at the School of Armour classified as 'Fully Functional' decreased from an average of 62 per cent in 2008 to 38 per cent in 2010. Since 2010, this has not improved: Defence advised that as at 19 March 2012 the proportion of vehicles classed as 'Fully Functional' was 39 per cent across Army. The main factors affecting vehicle availability have been a lack of supplies (spare parts) and mechanical failures.

84. Defence has established adequate facilities to maintain and operate the vehicles, and 7 RAR's move to Adelaide from Darwin in February 2011, allows the Battalion to take advantage of training areas which are not affected by the tropical climatic limitations of Darwin. The School of Armour also houses adequate facilities to provide training programs to M113 crews.

85. In terms of the second dimension of availability set out in paragraph 82, there has been considerable delay to the vehicles' design and production schedule. Defence estimates that the final vehicle will be delivered by December 2012.

86. In addition to the impact on capability resulting from production delays, the vehicles' overall capability is currently impacted by a lack of adequate communications equipment and logistical support. The M113 relies on the VIC 3 model communications harness as its main electronic communication system. There are currently a limited number of these harnesses available, and priority for these harnesses is given to the ASLAV vehicles, currently deployed to Afghanistan, which also share the VIC 3 platform. Army aims to rectify this shortage by December 2012 through fitting the Bushmaster fleet (some of which use the Vic 3 harness) with updated SOTAS communications systems, which will make an increased number of VIC 3 harnesses available for the upgraded M113 fleet.

⁶³ Although 46 vehicles had been issued to 7 RAR at the time of the audit fieldwork, vehicle usage by the Battalion was low compared to that of the School of Armour. Vehicle analysis was therefore based on the School of Armour's fleet as it would provide a more accurate picture of how the vehicles perform under combat conditions.

87. Moreover, the electronic systems fitted to the upgraded vehicles do not permit optimal communication and data transfer with heavy tanks and the other force elements, such as artillery and aircraft, with which they are intended to operate. These electronic systems are to be replaced by new battle space communications systems currently under development, which are scheduled to deliver new equipment in 2013, initially to infantry. Army originally expected to address the current communications limitations of the M113 by fitting to these vehicles the systems to be developed under projects LAND 75 and LAND 125.⁶⁴ However, in the context of the 2012–13 Federal Budget, the relevant phases of the linked projects, Land 75 and Land 125, that were to deliver these capabilities into the upgraded M113 vehicles will not now proceed. Defence informed ANAO that consideration will be given to including the installation of these capabilities in the upgraded M113s under later phases of these projects.

88. There are also restrictions transporting the upgraded vehicles using the ADF's native land, and air transport:

- C17 transport aircraft: Chief of Army informed ANAO that a single C17 has the capacity to carry up to four upgraded M113s, although the full air transportability certification process is still to be completed.
- C130 transport aircraft: Chief of Army also informed ANAO that a single upgraded M113 can be transported by a C130, although 'significant preparation of the aircraft is required and significant limitations on aircraft air-land performance would be imposed'. ANAO notes that the initial testing for loading the vehicle into a C130 occurred

⁶⁴ The Networking the Army Campaign Plan (NACP) identifies LAND 75 and LAND 125 as delivering the Army's core command and control systems. Together, these projects will provide Army with a Battle Group and below Command, Control and Communications (BGC3) System. The BGC3 requirement is for soldiers and their vehicles to wirelessly exchange combat data and voice communications. This capability is planned to be delivered and operationally tested to enable the Commonwealth to achieve its Networked Centric Warfare Milestone – Initial Networked Land Force. Generically the BGC3 System will consist of the following core sub-systems:

- a Battle Management System (BMS) for commanders, operators and HQ;
- a Combat Radio System (CRS) to provide voice and data services;
- a Network Management System (NMS) which will electronically integrate, configure, monitor and control the BMS and CRS;
- a Navigation System; and
- a Support System.

in March 2006. However, as at March 2012 certification for this procedure had yet to be achieved.

- Land transport: Army is able to utilise the heavy tank (M1A1 Abrams) transport capability of its Armoured battalions, and lease commercial vehicles to transport the upgraded M113s by road. The heavy trucks necessary for the mechanised infantry battalions to transport M113s are to be acquired under Phase 3 of the LAND 121 project. While the preferred tenderer for the medium-heavy vehicles was announced in December 2011, no date has been announced for delivering this capability.

89. In addition, ANAO was informed that upgraded M113s can be transported by sea aboard Navy's two currently available transport ships, HMAS Tobruk and HMAS Choules. However, this capability has yet to be tested. Capacity to move the vehicles by sea will increase with Phase 5 of Joint Project 2048, when the Canberra class helicopter landing dock vessels currently being constructed receive their landing craft. This is currently scheduled for 2017.

90. In summary, at the upgrade project's commencement, and throughout its life, there has been insufficient consideration by Defence of the FIC elements required for the upgraded vehicles to contribute as planned to Army's close-combat operations. With the project nearing completion, Defence has identified limitations with the vehicles' ability to communicate and be transported. Some of these limitations will not have been fully addressed by the time all 431 vehicles are scheduled to enter service in December 2012. There remains a fundamental challenge for Defence's senior leadership, when upgrading or developing a major system such as the M113, to coordinate all elements of the related FIC to avoid significant limitations to capability developing, as in the case of the upgraded M113.

91. In comparison with vehicles currently in use with other armed forces, the upgraded M113 lacks firepower and other vital capabilities. Although superior to its predecessor, a vehicle that was considered fit-for-purpose when the minor upgrade was first proposed 20 years ago now lags behind other armoured infantry vehicles, and is vulnerable in many current threat environments. This state of affairs was acknowledged by the Acting Chief of Army in December 2011:

It is important to note that while the M113AS4 (the upgraded M113) is a capable combat vehicle, it does have constraints and limitations through design and capacity as it is based on the M113A1 hull. This factor limits its

potential in comparison to higher order platforms including current generation IFV (infantry fighting vehicles). This fact essentially provides a capability gap for the conduct of mounted close combat operations across the spectrum of conflict until the introduction into service of the Land Combat Vehicle System (Land 400).

92. In response to the draft audit report, in April 2012 the Chief of Army provided clarifying comments on the use and meaning of the term ‘capability gap’:

The term refers to the difference between a stated capability requirement and Army’s ability to fulfil that requirement ...

While the existing level of protection of the [*upgraded M113*] is high, analysis shows that the vehicle’s major limitation will be its ability to support close combat operations against an enemy which is capable of employing a broad variety of conventional and unconventional methods of attack.⁶⁵

93. The Chief of Army also noted that:

as the Capability Manager ... I am satisfied that the [*upgraded M113*] provides a significantly enhanced capability to Army and that it is a potent and capable platform. I am also satisfied that the delivery of [*the upgrade project*] satisfies the original requirement specified by the Capability Manager.

Agency response

94. Defence’s response to the report is as follows:

Defence acknowledges this third Australian National Audit Office audit of the delivery of this particular capability. The audit report outlines the challenges that Defence and the contractor have experienced with the delivery of the Upgrade to the M113 Armoured Vehicle (LAND 106) project, but does not recognise the recent project deliverables and the importance of this capability to Defence.

In forming this observation, Defence notes that many of the improvements that the ANAO has suggested in previous audits, and to a lesser extent in this audit, are now in place or in the process of being implemented across Defence. Following the implementation of some of these improvements, Defence notes that, after overcoming some very challenging technical and commercial issues, the M113 project performance has significantly improved over the last year and is delivering the vehicles within the approved project budget and within

⁶⁵ The Chief of Army’s full response appears in Appendix 4 of this report.

the approved scope. Importantly, there are less than 70 vehicles to be delivered and the contractor is meeting the contract schedule for final delivery.

Conversely, Defence does acknowledge that a number of aspects of this project have not gone well over the life of the project and also acknowledges that there have been substantial delays during the project's life-cycle. Additionally, the ANAO correctly notes that Defence and the Contractor had been unduly optimistic regarding their ability to regain schedule and this optimism negatively impacted accurate project reporting. A major lesson learned by Defence is that, through the established reporting methods, senior management stakeholders, and Government should have been given a more accurate and frank picture of the status and risks to the project between 2007 and 2010. Since 2010, Defence has initiated additional assurance mechanisms to reduce the risk of this occurring again.

Capability Issues Raised in the Audit

During the course of this audit, Defence has highlighted the importance of the four capability enhancements provided by the M113AS4 including mobility, lethality, protection and communications. Furthermore, Defence has highlighted that the Armoured Personnel Carrier (APC) variant is the primary platform necessary for conducting mounted close combat. Moreover, the M113 platforms combine to provide a key capability within Army's Combined Arms Fighting System (CAFS).

In light of recent announcements regarding the placement into storage of various components of Army's mechanised systems, and specifically the M113,⁶⁶ Defence notes that this action is entirely related to the recent cuts to the Defence budget announced by the Government and the associated need to reduce operating costs in order to focus key resources to operational priorities and linked training support.

⁶⁶ ANAO comment: 100 APCs are being placed into storage.

Recommendation

Recommendation No.1

Paragraph 5.42

The ANAO recommends that, to maintain a focus on the delivery of the Fundamental Inputs to Capability (FIC) for each major capability project, including FIC elements to be delivered under other capability projects, Defence review at least annually the progress in developing FIC elements for each major capability project detailed in Joint Project Directives.

Defence response: Agreed.

Audit Findings

1. Introduction

This chapter recaps the origins and development of the M113 upgrade project and shows the current status of delivery and production. It also outlines the capability intended to be achieved and the results of previous audit and Parliamentary scrutiny, before setting out the audit approach.

Background

1.1 The M113 is a tracked vehicle used to transport and support infantry in a battlefield. M113s are the Australian Defence Force's (ADF's) only tracked armoured transport and, together with the Abrams tanks, they comprise the ADF's entire tracked capability. The M113s are fundamental equipment for Army's two mechanised battalions, the 5th and 7th Battalions, Royal Australian Regiment (5 RAR and 7 RAR).

1.2 While M113s can be deployed independently, their major role is to act in concert with other armoured vehicles (particularly tanks) as part of combined arms teams, supported by artillery and aircraft. The Armoured Personnel Carrier (APC) variant in particular provides tracked protection for infantry moving into and out of combat or areas of potential ambush.

1.3 Compared to wheeled vehicles (such as the Bushmaster and the Australian Light Armoured Vehicle—ASLAV), tracked vehicles provide better mobility in rough terrain, although they are slower and cannot travel such long distances on roads. M113s offer higher ballistic protection levels, however are more vulnerable to mines and improvised explosive devices (IEDs) because of their lower ground clearance.

1.4 M113s were designed in the late 1950s and were first introduced into service with Australian armed forces in the mid-1960s. Deliveries continued up until 1979 and, in all, Australia received more than 750 M113s.⁶⁷ Over that time, the M113's basic structure has remained unchanged, though the threats to its effectiveness have risen, notably from armour-piercing weapons and other explosive devices. In response, armed forces in other countries have upgraded

⁶⁷ Australia's M113s first saw service with the Australian Defence Force (ADF) during the Vietnam conflict, and most recently six were deployed in Timor-Leste as part of the International Stabilisation Force. Joint Committee of Public Accounts and Audit, *Auditor-General's reports Nos 18 to 31 (2008–09)*, Hansard, 15 June 2009, p. 21.

their M113 fleets to improve their operational capabilities and extend their useful lives.⁶⁸

1.5 The current upgrade of the ADF's M113 capability involves 431 vehicles at a total cost of some \$1 billion. The aim is to make the vehicles safer and more effective, and to extend their life until 2025 so as to provide an interim capability until the introduction of the ADF's next generation of infantry vehicles.

1.6 In essence, the upgrade is a complete re-build of the M113: only the original hull, rear door, hatches and communications systems are retained. The hull is lengthened, re-built and outfitted with new equipment including a new engine and transmission, new brakes and suspension, and for some vehicles a new electrically powered armoured turret and appliqué armour.

1.7 The major upgrade is being conducted under two contracts with the Prime Contractor. The inspection, preparation and lengthening of M113 hulls is undertaken through the Commercial Support Program (CSP) contract signed in December 1997.⁶⁹ The outfit of the lengthened hull with upgraded equipment is undertaken through the M113 Major Upgrade Project Contract (the Major Upgrade Contract) signed in July 2002. Both contracts were originally signed with Tenix Defence Pty Ltd,⁷⁰ however in June 2008 Tenix Defence was purchased by BAE Systems, which is now the Prime Contractor.⁷¹

Upgrading the Australian M113 fleet

1.8 The upgrade of Australia's M113 fleet has had a protracted history.⁷² A minimal upgrade of all M113s was first approved in 1993 at a cost of approximately \$50 million for completion by October 2000. In 1997, the Prime

⁶⁸ Canada has upgraded its M113 fleet, which included extending the vehicle's hulls. Other countries such as Norway and Germany have conducted upgrades which did not involve hull extension.

⁶⁹ The CSP Contract covers the maintenance of ADF vehicles, including the maintenance and rebuild of M113s.

⁷⁰ Tenix Defence was also the Prime Contractor engaged to undertake work during the 1990s in connection with the minimum upgrade project for the M113s.

⁷¹ Tenix Defence is referred to as the Original Prime Contractor in this report and BAE Systems is referred to as the Prime Contractor.

⁷² The history of the M113 upgrade is reported in more detail in previous ANAO audits: Report No.3 2005–06 and Report No.27 2008–09, both titled *Management of the M113 Armoured Personnel Carrier Upgrade Project*.

Contractor⁷³ selected for this initial upgrade approached Defence with an unsolicited proposal for a further upgrade of the M113 fleet, which included improved armoured protection and vehicle comfort. In June 1998, Defence decided to accept the Prime Contractor's unsolicited proposal, without testing the market with an open tender, and initial design work commenced in February 1999. However, the costs and savings forecasted by the Prime Contractor did not eventuate, and the Prime Contractor's proposal was formally declined in October 2000.

1.9 Defence sought additional funds for a major upgrade of the M113 fleet as part of the December 2000 Defence White Paper and was successful. The White Paper observed that the ADF's land forces required:

sufficient firepower, protection and mobility to provide clear advantage in any likely operations in defence of Australia or in our immediate region. [*Therefore the Government sought*] to introduce a program of rapid enhancements for our land forces [*including*] the major upgrade of 350 of our M113 Armoured Personnel Carrier fleet, with the upgraded vehicles planned to enter service from around 2005.⁷⁴

1.10 The major upgrade was included in the *Defence Capability Plan 2001–10*. The intention was to upgrade 350 original M113s to improve their protection, mobility, firepower and habitability, and retain them in service until around 2020.⁷⁵ In June 2002, the Government approved \$532 million to fund the major upgrade, bringing total approved spending to \$594 million (including previous approvals totalling \$62 million for minimal upgrades). Government's 2002 approval was on the basis of Defence advice that the proposed upgrade was the most cost-effective way of meeting Defence's needs, it represented value for money, and the technical aspects had been well defined such that the risks were judged as manageable. The intention was to achieve in-service capability by mid-to-late 2006. Table 1.1 summarises the evolution of the M113 upgrade, including the Government's October 2008 decision to add a further 81 vehicles to the major upgrade program.

⁷³ At this stage of the upgrade, the Prime Contractor was Tenix Defence Systems. BAE Systems purchased Tenix Defence Systems in June 2008 and is now the Prime Contractor for the project. The term 'Prime Contractor' is used throughout this report, rather than the name of the relevant commercial entity.

⁷⁴ Department of Defence, *Defence 2000: Our Future Defence Force*, 2000, pp. 82-83.

⁷⁵ Department of Defence, *Defence Capability Plan 2001–10 (Public Version)*, 2001, pp. 185-186. The DCP reported an estimated expenditure of between \$450 million and \$600 million.

Table 1.1**Evolution of the M113 major upgrade**

Upgrade	No. of vehicles	Approval date	Planned completion	Planned project cost (rounded to nearest \$ million)	Average budgeted cost per vehicle
Minimal upgrade	Phase 1: 537 Phase 2: 229	Phase 1: Nov 1993 Phase 2: not approved	Phase 1: December 1998 Phase 2: October 2000	Phase 1: \$40 million Phase 2: \$10 million	\$65 000
Revised minimal upgrade	Phase 1: 364 Phase 2: 154	Phase 1: April 1995 Phase 2: not approved	Both phases by March 2000	Phase 1: \$50 million Phase 2: not determined	\$137 000 (phase 1)
Expanded upgrade	Up to 347	February 1999	March 2004	\$335 million	\$965 000
Major upgrade ^(A)	350	June 2002	December 2010	\$594 million	\$1 697 000
Major upgrade, renegotiated ^(A)	350	October 2007	December 2010	\$624 million	\$1 783 000
Additional vehicles under ELF ^(B)	81	October 2008	December 2011	\$221 million	\$2 742 000
Current upgrade ^(A)	431	August 2011	December 2012	\$885 million	\$2 053 000

Note: (A) The 'planned project cost' and 'average budgeted cost per vehicle' for the 350 vehicles originally to be upgraded under the major upgrade contract do not incorporate the additional costs of extending the vehicles performed under the CSP Contract. As at December 2010, these CSP costs were approximately \$32.4 million.

(B) As part of the Enhanced Land Force initiative for Army, the Government agreed in October 2008 to the upgrade of a further 81 M113 vehicles by July 2011. All of these vehicles are APCs. Funding for hull extension work on the ELF APCs performed under the CSP was provided as part of the Government's approval, and is funded under the Major Upgrade Contract.

Source: ANAO Audit Report No. 27 2008–09 *Management of the M113 Armoured Personnel Carrier Upgrade Project*, updated based on ANAO analysis of Defence documentation.

1.11 While the prototype upgraded M113s were being tested in 2005, the Government approved the \$1.5 billion Hardened and Networked Army (HNA) initiative to increase the size and firepower of the ADF's land force, and to improve protection and communication networks for soldiers on the battlefield. HNA involved splitting the existing 5/7 mechanised battalion of the Royal Australian Regiment (5/7 RAR) into two separate battalions. 7 RAR

moved to Adelaide in 2011, while 5 RAR remained in Darwin, and both are to be equipped with upgraded M113s.

1.12 However, the prototype upgraded M113s experienced technical difficulties, including overheating and brake failures. Defence and the Prime Contractor entered into negotiations to resolve contractual and production issues, and agreement was reached in October 2007. The renegotiated contractual arrangements retained December 2010 as the deadline for the delivery of 350 upgraded M113s, but compressed the vehicle delivery schedule toward the back end of the Major Upgrade Contract.

1.13 As discussed in Audit Report No.27 2008–09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, the technical and production difficulties delayed the introduction into service of the upgraded vehicles. Originally planned for 2006, the initial tranche of vehicles was not accepted by Defence until November 2007.

1.14 In 2008, the Government approved the Enhanced Land Force (ELF) initiative, at a cost of approximately \$4.1 billion, to provide a larger and more capable Army. ELF included a proposal to purchase an additional 81 upgraded M113s (all the APC variant) so that both 5 RAR and 7 RAR could operate M113s exclusively, rather than a mixed fleet of M113s and Bushmasters. In February 2008, the Government approved the purchase of the additional 81 vehicles at a cost of \$222.1 million (2008–09 budget prices), bringing the total number of M113s to be upgraded to 431 and increasing the aggregate costs of the M113 upgrade to almost \$1 billion.⁷⁶

1.15 In May 2008, the then Parliamentary Secretary for Defence Procurement announced that the M113 upgrade project had been removed from the Defence Projects of Concern list after a number of technical issues that were impacting the vehicle delivery schedule had been resolved. He stated that the 350 vehicles then under contract would be delivered by December 2010 as per the original contract.⁷⁷

⁷⁶ This is comprised of the Land 106 project budget (\$884 million as at November 2011), approximately \$57 million in planned CSP costs, and project office staffing costs (estimated to be \$35 million in March 2009). These costs do not include costs associated with operating and maintaining the M113 fleet throughout its service life (see paragraph 3.7).

⁷⁷ Parliamentary Secretary for Defence Procurement, *Speech to the Defence Watch Luncheon*, 22 May 2008.

1.16 In August 2009, the Government also approved the extension of the last unextended variant, the Armoured Mortar, at a cost of \$17.1 million. The resulting contract amendment pushed the scheduled completion date for the last vehicle out to April 2012. A subsequent contract renegotiation, concluded in August 2011, pushed the final vehicle completion date out to December 2012 (this renegotiation is discussed in chapter 4).

1.17 The current status of expenditure and production is summarised in Table 1.2, reflecting the costs and schedules incorporated under the most recent amendments to the CSP Contract and Major Upgrade Contract.

Table 1.2

Current cost and schedule status of the M113 upgrade

Component	Status
Cost^(A)	
Major upgrade project budget expended (as at November 2011)	\$724 million
Major upgrade project budget remaining (as at November 2011)	\$160 million
Total approved major upgrade project budget (November 2011 out-turned dollars)	\$884 million
CSP expended (as at December 2010)	\$32.43 million
Estimated cost of operating upgraded vehicles (up to July 2011)	\$46.6 million
Schedule (as at March 2012)	
Vehicles accepted by Defence (including IPVs) ^(B)	356
Vehicles left to be accepted	75
Contracted due date for all vehicles	December 2012

Notes: (A) These are the latest costs available, based on Defence advice.

(B) 14 Initial Production Vehicles (IPVs) have been delivered, at least one of all seven variants. IPVs were used by DMO to undertake design testing and verify that the Prime Contractor was ready to commence full-scale production of the variant. During the course of the project, the IPVs are to be brought up to a Production Vehicle standard.

Source: ANAO analysis of Defence information.

Continuing requirement for M113s

1.18 Since originally deciding to undertake the major upgrade more than 10 years ago, Defence has at various times reaffirmed its requirement for M113s and rejected alternative platforms. A November 2000 Defence stakeholder review considered alternatives, including the acquisition of a new vehicle, before reaffirming the need for a tracked capability and rejecting the purchase of replacement vehicles (such as the United States' Bradley fighting vehicle) as prohibitively expensive.⁷⁸

1.19 In February 2007, the Chief of Army considered M113 options, including possible alternatives, which were rejected because they could not offer the range of platform variants that could be built from the M113 family of vehicles. In May 2007, Defence informed Parliament that:

Defence has reviewed the capability requirement and confirmed the continued suitability and need for this family of vehicles. The option of cancelling the project would leave a significant gap in the ADF's capability and is not being considered at this stage.⁷⁹

There is no comparable alternative family of vehicles on the world market that provides the additional vehicle functions of digitally controlled electric turret, maintenance, recovery, ambulance, command and control, mortar and cargo.⁸⁰

1.20 In October 2008, at the time of the Government's consideration of tracked vehicles to support the ELF initiative, Defence's advice was that alternatives, such as the Bradley vehicles,⁸¹ were too costly, would create difficulties through operating mixed vehicle fleets, and would not capitalise on the successful investment under the M113 upgrade project.

1.21 In June 2009, Defence advised Parliament that the M113s were very much needed to give Army the range of capabilities that it required to respond to operational tasks across the spectrum of potential conflicts envisaged by government:

⁷⁸ Defence Materiel Organisation, *Response to a Question on Notice from the Joint Committee of Public Accounts and Audit*, submission No. 5, received 28 August 2009.

⁷⁹ Department of Defence response to questions on notice, May 2007 Budget Estimates, question o.

⁸⁰ Department of Defence response to questions on notice, May 2007 Budget Estimates, question i.

⁸¹ The Bradley is a tracked American fighting vehicle that entered service with the United States Army in the early 1980s. There are several variants in the Bradley family of vehicles, and the main variant is the M2 Bradley infantry fight vehicle, which performs a troop transport role comparable to the M113 APC.

[M113s] provide you a capability that you can employ in hot, wet tropical environments where there is a lot of mud and things that wheeled vehicles will have trouble with.

[*They will be needed*] over the next 10 to 20 years because of the range of contingencies we face, specifically in northern Australia and in some of the wet and tropical areas.⁸²

1.22 At the same hearing of the Joint Committee of Public Accounts and Audit (JCPAA), Defence informed Parliament that the ASLAV and Bushmaster vehicles were the best vehicles for Australia's deployment to Afghanistan, rather than M113s. Defence informed the JCPAA that it preferred not to use M113s where sustained close combat would be expected on a daily basis. Defence further informed the JCPAA it was unlikely that the M113s would be deployed in a combat environment such as Afghanistan, and they would instead be used primarily in the defence of northern Australia.⁸³

1.23 In August 2009, Defence expressed to Parliament its requirement for M113s in the following terms:

This assessment remains current. To use the Bradley example, the vehicle carries half the troops in comparison to the M113, and therefore Defence would need to buy twice the number of vehicles. Secondly, the Bradley costs four times the M113 Upgrade cost and thirdly, the Bradley is 30 tonne and cannot be deployed by C130 (C17s are not suitable for the small dirt strips in our region).⁸⁴

⁸² Joint Committee of Public Accounts and Audit, *Review of Auditor-General's reports Nos 18 to 31 (2008–09)*, 15 June 2009, pp. 19, 23; Joint Committee of Public Accounts and Audit, *Report 417: Review of the Auditor-General's Reports tabled between February 2009 and September 2009*, June 2010, p. 31.

⁸³ Defence informed Parliament that it was investigating the cost of additional protection measures required should the vehicles be deployed to Afghanistan, as well as independently testing protection measures. Defence had previously estimated the additional costs of such protection as being in the order of \$176 900 per vehicle. Joint Committee of Public Accounts and Audit, *Review of Auditor-General's reports Nos 18 to 31 (2008–09)*, 15 June 2009, pp. 20–21; Joint Committee of Public Accounts and Audit, *Report 417: Review of the Auditor-General's Reports tabled between February 2009 and September 2009*, June 2010, p. 30.

⁸⁴ Defence Materiel Organisation, *Response to a Question on Notice from the Joint Committee of Public Accounts and Audit*, submission No. 5, received 28 August 2009.

1.24 The current Materiel Acquisition Agreement⁸⁵ for the M113 upgrade project was signed in December 2011, after capability requirements were reviewed by Army and the Capability Development Group, who confirmed the suitability of, and Defence's need for, the M113 vehicles.

1.25 As at December 2010, Defence had accepted a total of 194 vehicles, 156 short of the 350 required under the terms of the Major Upgrade Contract as renegotiated in October 2007. The delivery and usage of the vehicles at the time of audit fieldwork is summarised in Table 1.3. As at 4 March 2012, a total of 356 vehicles had been accepted by Defence, of which 288 had been delivered to Army.

Table 1.3

Current delivery and usage of upgraded M113s

Item	Status
Vehicles delivered to Army (as at March 2012)	252 (1 Brigade) 24 (School of Armour) 12 (Other Units)
Average vehicle usage by Army per vehicle (between January & November 2011)	876km/138hrs
Status of upgraded M113s delivered to Army (as at March 2012)	Fully Functional: 39% Restricted Use ^(A) : 37% Do Not Use: 24%

Note: (A) Vehicles are classified as 'Restricted Use' when they carry defects and/or damage, but are able to be driven subject to restrictions (see Table 5.2).

Source: Defence information and ANAO analysis.

⁸⁵ A Materiel Acquisition Agreement (MAA) is an agreement between Defence and DMO. It specifies what DMO (as supplier) will deliver to Capability Development Group and Army (as customers) for how much and when. It also provides a means by which performance will be monitored over the course of a project. The Agreement documents the high-level outputs DMO has undertaken to deliver. The most recent iteration of the M113 upgrade MAA was signed in December 2011, incorporating the outcomes of the 2011 contract renegotiation.

Developing capability

1.26 Defence defines capability as the ‘capacity or ability to achieve an operational effect. An operational effect may be defined or described in terms of the nature of the effect and of how, when, where and for how long it is produced’.⁸⁶ Achieving capability requires more than purchasing equipment; capability involves combining the multiple personnel, equipment and support system inputs, codified in the Fundamental Inputs to Capability (FIC—see Table 5.1 and Appendix 1).

1.27 In the case of the upgraded M113s, these fundamental inputs include the vehicles along with (for example) the systems and arrangements for training personnel, for administering equipment parts and spares and conducting maintenance, as well as those for overseeing and planning operations and exercises. Achieving capability with the upgraded M113s requires battle doctrine and plans to be developed, crews to be trained and exercised with the vehicles (preferably in concert with tanks) to test doctrine and plans, for performance to be evaluated and lessons learned, and for the logistics chain, including repairs and spares, to be effectively in place.

Previous ANAO audits and parliamentary oversight

1.28 The ANAO first audited the M113 Upgrade Project in 2005, and Audit Report No.3 2005–06 *Management of the M113 Armoured Personnel Carrier Upgrade Project* was tabled in the Parliament on 28 July 2005. The ANAO reported that, since its inception, the project had undergone extensive scope changes and schedule delays. The minimum upgrade phase of the project had been hampered by poor project management, inadequately defined project objectives, ineffective project planning, and technical problems. While the audit report noted that the major upgrade contract signed in 2002 provided an improved framework for the project, the ANAO doubted whether the project would meet the then planned date of late 2006 for the introduction into service of the upgraded M113s.⁸⁷

1.29 The ANAO conducted a second audit in 2008–09, and Audit Report No.27 2008–09 *Management of the M113 Armoured Personnel Carrier Upgrade*

⁸⁶ Department of Defence, *Defence Capability Development Handbook*, Canberra, August 2011, p. 2.

⁸⁷ ANAO Audit Report No.3 2005–06 *Management of the M113 Armoured Personnel Carrier Upgrade Project*, p. 14.

Project was tabled on 27 March 2009 (Appendix 2 lists the recommendations from both previous ANAO audits). At that time, the project was in the initial stages of vehicle production, following the conclusion in October 2007 of global settlement negotiations to resolve contractual difficulties with the Prime Contractor and establish a new delivery schedule.

1.30 However, the 2008–09 audit identified that, following the October 2007 global settlement, vehicle production had been slow and, despite additional production then planned to commence at two further sites (Williamstown in Victoria and Wingfield in South Australia), recovering the production schedule would be challenging.

1.31 At the time of the second audit, the first 16 upgraded M113s were stationed at the then 5/7 RAR in Darwin, and Defence informed the ANAO that it had achieved a limited initial operating capability with M113s. The audit report also identified that training was underway but had suffered the necessary interruptions of dismounting trained crews to deploy them overseas for operations. Exercises using the M113s had only just commenced and combined arms training with tanks and other force elements had yet to occur. The logistics support chain was rudimentary and the reliability of the vehicles had yet to be gauged.

1.32 In June 2009, the JCPAA held a public hearing in the course of its inquiry into the 2008–09 audit report, at which time DMO expressed optimism that the project would recover from a one year delay and deliver the contracted 350 vehicles by December 2010, although DMO noted that the schedule was high risk.⁸⁸

1.33 In its report on this inquiry, the JCPAA expressed its concern that there was a high risk that the project may not be completed on time, and advised DMO to ‘ensure its staff are aware of their responsibilities to report potential scope changes to key decision makers’.⁸⁹ The Committee requested Defence to provide it with updates on the progress of the project and on the steps taken to ensure adherence to existing processes for scope changes.

⁸⁸ Head Land Systems cited in Joint Committee of Public Accounts and Audit, *Review of Auditor-General's reports Nos 18 to 31 (2008–09)*, 15 June 2009, p. 18; Joint Committee of Public Accounts and Audit, *Report 417: Review of the Auditor-General's Reports tabled between February 2009 and September 2009*, June 2010, p. 30.

⁸⁹ JCPAA Report 417, *Review of the Auditor-General's Reports tabled between February 2009 and September 2009*, June 2010, p. 31.

Audit approach

1.34 As discussed at paragraphs 1.28 and 1.29, ANAO has conducted two previous audits of this project.⁹⁰ Defence's overall response to the 2008–09 audit included the following statement:

The M113 Armoured Personnel Carrier vehicle fleet is undergoing a major upgrade under Project Land 106 which will realise a significant capability improvement over its current design. The Defence Materiel Organisation is charged with managing the \$850 million Project and will deliver 350 upgraded M113 vehicles by December 2010 and [an] additional 81 upgraded vehicles under the Enhanced Land Force initiative by 2011.

1.35 ANAO commenced this third audit of the major upgrade project in November 2010, shortly before the last of the original 350 vehicles were due to be delivered under the contract schedule, both as originally framed in 2002, and as in place at the time of the 2008–09 audit. The objective of the audit was to assess the progress of the M113 Upgrade Project—LAND 106,⁹¹ including progress in the development of operational capability resulting from the introduction of the upgraded vehicles into service. The high-level audit criteria used to assess the project's progress and Defence's effectiveness in administering the M113 Upgrade Project were:

- the degree to which the schedule for the production and delivery of upgraded M113 vehicles to Defence had been recovered in accordance with Defence's March 2009 response to the 2008–09 audit report and contractual requirements, as negotiated over the life of the contract;
- Defence's measurement and allocation of the total cost of the upgrade project; and
- the development of capability arising from the upgrade project.

1.36 Audit fieldwork was conducted during the period November 2010 to October 2011. The audit was conducted in accordance with ANAO auditing standards at a cost to the ANAO of \$625 000.

⁹⁰ Audit Report No.3 2005–06 and Audit Report No.27 2008–09, both entitled *Management of the M113 Armoured Personnel Carrier Upgrade Project*.

⁹¹ 'LAND 106' is Defence's project code for the M113 upgrade project.

Report structure

1.37 The remainder of the report is organised into four chapters:

- Chapter 2 outlines the seven variants of the upgraded M113s that are to be produced, particularly focusing on the mortar and logistics variants, and the knock-on effects of related scope changes on schedule;
- Chapter 3 analyses cost and schedule performance, including whole-of-life costs;
- Chapter 4 examines the steps taken to recover the production schedule, the renegotiation of the major upgrade contract concluded in August 2011, and reporting to senior decision-makers and government on the project over time; and
- Chapter 5 reviews the operational capability currently provided by the M113s.

2. Managing vehicle design and project scope

This chapter outlines the seven variants of upgraded M113 that are to be produced, with particular attention to the mortar and logistics variants, for which designs have recently been finalised. The knock-on effects of related scope changes on schedule are also discussed.

Introduction

2.1 Since the major upgrade was approved in 2002, there have been a number of significant changes to the M113 upgrade project's scope and cost. These have included modifications to the individual variant upgrades, as well as the significant expansion of the project to include an additional 81 vehicles under the ELF initiative, increasing the total number of vehicles to be upgraded from 350 to 431.

2.2 Table 2.1 lists the seven variants of upgraded M113 vehicles, along with the composition of the stock fleet and the number of upgraded vehicles intended to be produced. The cost of producing each upgraded variant is different, with the Armoured Mortar (AM) variant the most expensive and the Armoured Logistics Vehicle (ALV) the least expensive. The Armoured Personnel Carrier (APC), Armoured Fitter (AF), Armoured Command Vehicle (ACV), ALV and Armoured Ambulance (AA) variants are each based on the original M113 APC hull. The upgraded Armoured Recovery Vehicle Light (ARVL) and AM vehicles are each being built from their original hulls, which differ to the APC hulls.

2.3 The final approved designs for each of the seven variants included extension of the hulls. Although it had not been originally envisaged that it would be necessary to extend the ACV, AA, ARVL and AM, decisions to amend the scope of the Major Upgrade Contract to include the extension of these variants have been made progressively over the life of the major upgrade project. The ARVL was approved for extension in July 2005. In September 2007, the extension of the AA and ACV variants was approved. Finally, the Government approved the extension of the AM in July 2009.

Table 2.1

Variants comprising Australia's M113 fleet and their upgrade status, as at March 2012

Variant (average cost per vehicle) ^(A)	Role	Fleet numbers		
		Original un- upgraded vehicles	Vehicles upgraded ^(B)	Vehicles remaining to be upgraded
Armoured Personnel Carrier (APC) (\$1.74 million)	Carry troops and their equipment	527	243	9
Armoured Fitter (AF) (\$1.34 million)	Repair vehicles in the field	41	38	0
Armoured Recovery Vehicle Light (ARVL) (\$1.65 million)	Recover vehicles from the field	19	12	0
Armoured Logistics Vehicle (ALV) (\$1.10 million)	Transport equipment and supplies	100	4	46
Armoured Ambulance (AA) (\$1.34 million)	Transport wounded troops	0	15	0
Armoured Command Vehicle (ACV) (\$1.19 million)	Field command post, communications hub	58	43	0
Armoured Mortar (AM) (\$2.05 million)	Transport and support an 81 mm mortar	22	1	20
Totals		767	356	75

Notes: (A) Average vehicle cost is based on production costs from December 2010 to November 2011. For the ARVL, average unit cost is based on earlier data, as all vehicles of this variant had been produced before December 2010. The average costs do not include Commercial Support Program (CSP) costs.

(B) This column includes the 14 prototype Initial Production Vehicles (IPVs). However, the IPVs will require significant rework to be brought up to a production vehicle standard.

Source: ANAO analysis of Defence data.

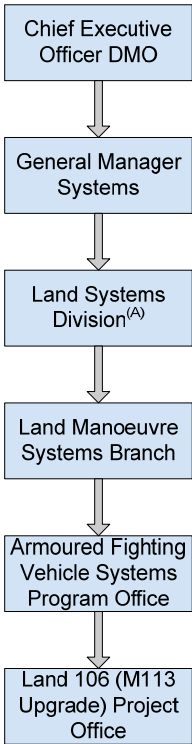
Management arrangements

2.4 The responsibilities of the Defence organisations involved in the project are outlined in the project's Materiel Acquisition Agreement, which stipulates that DMO is the supplier and the design authority, Defence is the customer (represented by Capability Development Group), and the Chief of Army is the

Capability Manager. DMO is the lead agency for the upgrade project, and its organisational structure as it pertains to the M113 project is outlined in Figure 2.1. The Armoured Fighting Vehicle Systems Program Office, located within Land Systems Division, is responsible for administering the Major Upgrade Contract on behalf of Defence. However, the Commercial Support Program Contract, under which work to prepare the hulls for upgrade is conducted, is administrated by Defence’s Joint Logistics Unit, outside of DMO.

Figure 2.1

DMO management structure for M113 upgrade project



Note: (A) Head Land Systems is the DMO (Supplier) delegate for the Materiel Acquisition Agreement.

Source: ANAO analysis of Defence documentation.

2.5 DMO is responsible for the day-to-day management of the upgrade project, including liaison with the Prime Contractor and consultation with Army. DMO is also responsible for managing the design of the M113s and, with Army, is responsible for managing the scope of the project, including any variations to the design that affect cost and capability.

2.6 In addition to responsibility for identifying potential scope changes and seeking their approval, DMO is responsible for developing and proposing

engineering solutions, test and evaluation procedures, and for approving any resulting change to design. DMO is the Design Acceptance Authority and both acceptance and operational test and evaluation authority for the M113 project, since the Army's operational test and evaluation organisation (the Land Engineering Agency) is part of DMO. This arrangement differs from those of Navy and Air Force, and is at odds with the important test and evaluation principle that the organisation responsible for operational test and evaluation should be, and be seen to be, independent of the equipment acquisition organisation.⁹²

Design management framework for the upgrade of the M113 fleet

2.7 To govern the design and construction of the upgraded M113s, the Major Upgrade Contract includes procedures adapted from the US military standard *Technical Reviews and Audits for Systems, Equipments, and Computer Software* (MIL-STD-1521B) in order to ensure that each M113 variant is fit for purpose.⁹³ The systems engineering⁹⁴ framework embodied in MIL-STD-1521B is intended to provide a disciplined approach to managing the technical and program-management issues that arise during complex projects, and allow decision-makers to effectively manage cost and schedule against the intended capability outcome. This includes considering the opportunity costs involved, bearing in mind that qualitative judgements are inherent in managing all major defence projects.⁹⁵

2.8 In accordance with systems engineering principles, MIL-STD-1521B prescribes critical design reviews and audits that gauge the state of design and construction. Successful completion of these reviews and audits demonstrates

⁹² ANAO Audit Report No.46 2001–02, *Test and Evaluation of Major Defence Equipment Acquisitions*, pp. 46–47, 84–86.

⁹³ MIL-STD-1521B is a US Air Force standard that was cancelled in 1995.

⁹⁴ 'Systems engineering involves the orderly process of bringing complicated systems into being through an integrated set of phased processes covering user requirements definition, system design, development and production, and operational system support.' See Bengamin. S. Blanchard, *System Engineering Management*, John Wiley & Sons, Second Edition, 1998, pp.1, 10–12, 35–48.

ANAO Audit Report No. 57 of 2010–11, *Acceptance into Service of Naval Capability*, noted that 'Successful systems engineering is dependent on both *technological* expertise and *management* expertise' (p. 12).

⁹⁵ Australian Strategic Policy Institute, 'Three views of risk: selecting and acquiring military equipment', *Special Report*, Issue 42, November 2011, p. 2.

that prototypes have been well-engineered to meet specifications, and provides management assurance that they are ready to enter full-scale production. In the case of the M113 upgrade project, the key milestones are the Preliminary Design Review, Critical Design Review, the Functional Configuration Audit, the Physical Configuration Audit, and the Production Readiness Review (PRR).

2.9 By the conclusion of the 2008–09 ANAO audit in March 2009, three of the seven variants (the APC, AF and ARVL) had successfully completed all relevant MIL-STD-1521B reviews and audits and had been cleared for production.⁹⁶ By this time approval had also been received to extend both the ACV and AA variants (in September 2007). The ACV and the AA were then cleared for production after successfully completing their respective PRRs in January 2010 and March 2010. Prior to this, at the Critical Design Reviews for these variants, additional modifications of the ACV and AA were identified as necessary in order to redress capability shortfalls and additional Army capability requirements, resulting in a total additional cost of \$1.7 million (October 2001 base-date dollars).

2.10 At the time of initial audit fieldwork for this audit in October 2010, the ALV and AM variants were yet to successfully complete their PRRs. Each vehicle subsequently passed their PRRs, the ALV in April 2011 and the AM in September 2011. The design management of each of these last two variants is considered below.

Design development of the Armoured Logistics Vehicle (ALV)

2.11 Two prototype ALVs were delivered to DMO in February 2009 (see Figure 2.2). However, the prototypes twice failed their PRR (held in July 2009 and September 2009) because the vehicle's ground clearance was insufficient in certain critical circumstances.⁹⁷ To remediate the problem, new torsion bars were designed and fitted to the vehicle suspension system. DMO Head Land

⁹⁶ These three variants all completed their Production Readiness Reviews in November 2007. Under US Military Standard 1521B, a PRR determines the status of completion of required actions prior to making a production go-ahead decision. The review is accomplished in an incremental fashion during the full-scale development phase, with the final review assessing the risk in exercising the production go-ahead decision.

⁹⁷ These prototype vehicles are known as Initial Production Vehicles (IPVs).

Systems was briefed in November 2010 that results of regression testing of the solution were very positive, and that production would likely be delayed until April 2011. Engineering development testing of the ALV IPVs upgraded suspension was conducted by the Prime Contractor between September and December 2010. In January 2011, the Prime Contractor provided DMO with the report of testing results showing that the modified torsion bars met the vehicle's ground clearance requirements.

Figure 2.2

Armoured Logistics Variant



Source: Defence Materiel Organisation.

2.12 While the ALV subsequently passed its PRR in April 2011, production of ALVs did not start until November 2011, with four ALVs produced as at March 2012. Defence advised ANAO in March 2012 that full ALV production will commence in late April 2012 once APC production has finished.

Design development of the Armoured Mortar (AM)

2.13 As noted in paragraph 2.3, Defence did not originally plan to extend the Armoured Mortar (AM) variant. However, the February 2009 System

Design Review of the AM noted that, unless the hull was extended, there was a risk that the vehicle would exceed its recommended gross vehicle mass when the appliqué armour, belly plate and track shroud were fitted.⁹⁸

2.14 In March 2009, during the course of the previous ANAO audit, Defence informed ANAO that it was considering a proposal to extend the AM using APC hulls rather than the existing mortar hulls. However, in August 2009, Defence received the Minister's agreement to extend the mortar vehicles based on their original hulls, retaining the existing mortar base plate unmodified. The scope change business case submitted to the Minister in June 2009 stated:

Stretching the AM...represents a significant capability enhancement that will ensure the vehicles can meet their key functional requirements as well as providing an adequate technical growth margin for the remaining life of type of the M113 fleet.

[This will] reduce the cost and complexity of fleet maintenance over the life of type of the fleet. The estimated savings delivered through fleet uniformity and the potential increase in cost to deliver this upgrade once the production line has closed outweigh the higher acquisition cost and the marginally higher direct operating costs [of] standard vehicles.⁹⁹

2.15 One of the improvements offered by extending the AM was the ability for the mortar to be raised and lowered at the 12 o'clock position (without an extended hull, there was not enough space). Defence informed the ANAO in March 2012 that this was the key reason for seeking the Minister's agreement to the scope change because it enabled:

quick stowage of the mortar in the 12 o'clock position to enable the vehicle to move quickly away—otherwise the mortar would need to be rotated to the six o'clock position for stowage—taking valuable time.

2.16 Defence informed the Minister in the business case that:

⁹⁸ The Intergovernmental Agreement for Regulatory and Operational Reform in Road, Rail and Intermodal Transport defines the gross vehicle mass of a vehicle as the maximum loaded mass of the vehicle originally specified by the vehicle's manufacturer or as specified by the relevant registration authority if it has not been specified by the manufacturer or has been modified such that the manufacturer's original specification no longer applies <http://www.atcouncil.gov.au/documents/files/NTC_IGA1.pdf>.

⁹⁹ Department of Defence, *Scope change business case for Project Land 106 – Armoured Mortar variant stretch*, submitted to Minister for Defence, June 2009.

Army has cited this capability as a critical requirement for the upgraded vehicle.¹⁰⁰

2.17 From an operational perspective, the additional space also allows extra stowage and enables a greater payload of ammunition, so that the AM can provide protected ammunition resupply. Defence also considered that extending the vehicle achieved a more uniform vehicle appearance (so that individual variants are harder to distinguish and target), permits the future installation of Defence's planned Battle Management System¹⁰¹ and other future, computer-based, indirect fire-control systems, and can potentially accommodate a longer barrelled or larger calibre future mortar system.

2.18 Defence identified future savings from extending the AM, arising in relation to the future replacement of Army's existing 81mm mortars (if this occurred before the scheduled retirement of the M113s in 2025), and the future need to accommodate extra protection suites and future combat systems. As the unextended AM could not accommodate these projected improvements, the cost of re-establishing the production line in the future to extend the hulls was estimated to be \$36.2 million, compared to the estimated \$17.1 million required to undertake the extension during current production, a potential future saving of \$19.1 million. However, the bulk of these identified savings are to flow from future capability decisions, and there are currently no plans to

¹⁰⁰ The submission stated that Army prefers to fire the mortar at the 12 o'clock position, as the vehicle has better armour protection to the frontal arcs. Having to raise, lower and stow the mortar at 6 o'clock position means it takes more time to deploy to, and lower from, the 12 o'clock position, and therefore 'significantly increases the vulnerability of the vehicle crew to counter-battery fire'.

Department of Defence, *Scope change business case for Project Land 106 – Armoured Mortar variant stretch*, submitted to Minister for Defence, June 2009.

¹⁰¹ The Networking the Army Campaign Plan (NACP) identifies the Land 75 and Land 125 projects as delivering the Army's core command and control systems. Together these projects aim to provide Army with a Battle Group and below Command, Control and Communications (BGC3) System.

The BGC3 requirement is for soldiers and their vehicles to wirelessly exchange combat data and voice communications. This capability is planned to be delivered and operationally tested to enable Defence to achieve its Networked Centric Warfare Milestone – Initial Networked Land Force.

Generically the BGC3 System will consist of the following core sub systems:

- a Battle Management System (BMS) for commanders, operators and HQ;
- a Combat Radio System (CRS) to provide voice and data services;
- a Network Management System (NMS) which will electronically integrate, configure, monitor and control the BMS and CRS;
- a Navigation System; and
- a Support System.

replace the 81mm mortar in the AM variant. Defence informed ANAO in March 2012 that:

At the time Army was considering a future mortar weapon system replacement and it was prudent to adjust the design of the AM in this early stage to cater for this potential outcome. The fact that a later decision [*was made*] not to proceed on a mortar system replacement does not mean that that the decision to adjust the design of the AM at the time was incorrect.

2.19 The AM scope change business case listed the logistic advantages of adopting the common construction of the extended hulls as:

- a fleet-wide, common regime of driver and maintainer training and qualifications;
- a fleet-wide performance and handling baseline, simplifying tactical planning for commanders; and
- commonality of repair parts, appliqué armour components,¹⁰² and transport procedures.¹⁰³

2.20 Defence advised the Minister that it estimated that these advantages would provide \$3.66 million in additional savings over the life of the vehicle including reduced attrition, as the extended AM would no longer have to operate as close to its recommended gross vehicle mass. Defence was unable to provide to the ANAO the detailed calculations from which the estimate of these savings was derived.

2.21 The calculation of the \$17.1 million total cost of extending the AM variant included \$2.5 million for hull extension work to be performed by the Prime Contractor under the CSP Contract. Funds for CSP work are generally sourced from Army's vehicle fleet sustainment budget.¹⁰⁴ In the AM scope change business case, Defence sought Ministerial approval to instead fund the extension of the 21 AMs from Land 106's contingency fund on the basis that:

¹⁰² Under the Major Upgrade Contract, the AM vehicles are fitted 'for', but not 'with', appliqué armour panels, side skirts and belly plates.

¹⁰³ There are, however, several areas where the AM sub-frame structure has led to trade-offs of family of vehicles commonality, with some parts unique to the mortar vehicles, which may lead to performance differences with other variants. These include a unique hull extension kit, as the APC kit cannot be used, and parts of the fuel system, fording system, suspension and hydraulic system.

¹⁰⁴ See paragraphs 3.14 to 3.27.

The option of using the contingency provision to fund this scope change is appropriate because Land 106 is a pre-Kinnaird review project and all contingency was transferred to DMO at second pass approval.¹⁰⁵

2.22 After conferring with the Prime Minister and Minister for Finance, the Minister approved the extension in August 2009.

Assessing the risks of the AM extension

2.23 A June 2010 Preliminary Design Review meeting for the AM variant identified a range of technical risks associated with the extension, including those posed by unrecoverable hull deformation, hull fatigue, unknown suspension system performance when the mortar was fired, and cracking of the mortar turntable structure caused by past usage.¹⁰⁶ The known mortar turntable problems (caused by stresses from mortar round firing in the forward direction) necessitated the development of a unique repair technique, since:

a [United States] repair technique does not exist, [the United States] rectify through replacement of the entire hull.¹⁰⁷

2.24 As discussed in paragraph 2.14, in March 2009 Defence was considering a proposal to extend the AM using APC hulls rather than the existing mortar hulls. The APC is the most common variant in the M113 fleet, and accordingly there is a large stock of APC hulls from which to select candidates for upgrade. However, after further investigation Defence made the decision to extend the AM based on its original hull, because using an APC hull would have required a redesign of the mortar turntable and its support structure.

¹⁰⁵ Department of Defence, *Scope change business case for Project Land 106 – Armoured Mortar variant stretch*, submitted to Minister for Defence, June 2009.

¹⁰⁶ The Preliminary Design Review is the second systems engineering review conducted as part of M113 variant development. As stated in US Military Standard 1521B, a Preliminary Design Review:

evaluates the progress, technical adequacy, and risk resolution (on a technical, cost and schedule basis) of the design approach; determines its compatibility with performance and engineering speciality requirements of the Hardware Configuration Item development specification; evaluates the degree of definition and assess the technical risk associated with selected manufacturing methods/processes; and establishes the existence and compatibility of the physical and functional interfaces among the configuration item and other items of equipment, facilities, computer software and personal.

¹⁰⁷ Defence Materiel Organisation, *Summary of outcomes from Land 106 M113 Upgrade Project – Project Management Stakeholder Group Meeting*, 10 June 2010.

2.25 Accordingly, in August 2009 Defence requested and received the Minister's agreement to extend the AM based on their original hulls, including the original baseplate. There are only 22 extant AM hulls (see Figure 2.3) available from which to select 21 suitable to extend and upgrade, in order to provide the number of AMs required. The Prime Contractor has acknowledged that the limited number of hulls to choose from could slow production, as badly damaged hulls will need more time to be repaired.¹⁰⁸ Defence had informed the Minister in the June 2009 scope change business case that overall the technical and cost risk posed by the AM extension was assessed as low.¹⁰⁹

Figure 2.3

One of the 22 original Armoured Mortar variants awaiting upgrade at Bandiana



Source: ANAO fieldwork at Bandiana facilities, September 2011.

¹⁰⁸ This risk has been realised, with one AM hull requiring in excess of 900 hours work due to damage it had sustained in the Vietnam conflict some 40 years ago which had never been fully fixed. The damage was so severe it could not be rectified and the damaged section of the hull had to be cut away, and replaced with a section of an APC hull.

¹⁰⁹ The AM extension business case noted that the variant is 16 per cent more expensive than the ambulance because of extra work on mortar mount and extra design, development and testing costs.

2.26 The business case further stated that the schedule risk to the upgrade project of extending the AM was assessed as 'low-medium', lower than the schedule risk assessment associated with not extending the AM, which was rated as a 'medium'. On this basis, the indicative schedule in the business case showed development and acceptance testing of the extended AM scheduled for completion in July 2011 and vehicle production to be completed over 60 days by mid-October 2011. The schedule risk assessment was based upon a March 2009 schedule recovery plan that indicated expected assembly of 12 vehicles per month at the Bandiana facility. However, in December 2008, Defence was already aware that the Prime Contractor could not achieve this rate of production at the Bandiana facility.

2.27 The PRR for the AM was completed in September 2011. These vehicles are now scheduled to be produced last, between June 2012 and December 2012.¹¹⁰ A November 2010 project review conducted by DMO noted that producing the AMs last:

conflicts with Army's preference to have the armoured mortar vehicles delivered as early as possible.¹¹¹

Assessing the impact of project scope changes

2.28 In May 2008, DMO informed the Parliamentary Secretary for Defence Procurement that, in its view, the major technical risks in the development of the M113 fleet were retired when the APC variant successfully completed its PRR in November 2007. Given the level of commonality to the other variants, DMO considered that the testing and development of the remaining variants was lower risk.

2.29 However, as shown in Figure 2.4, this has not proven to be the case, and each variant has suffered extended delays (indicated by the yellow box) in the completion of its PRR, measured against the original schedule approved by the Government in 2002.¹¹² The delays for the ALV and AM were particularly

¹¹⁰ Originally, the 81 APCs to be procured under the ELF initiative were scheduled to be produced last, however production of the ELF vehicles were brought forward. See paragraph 3.16.

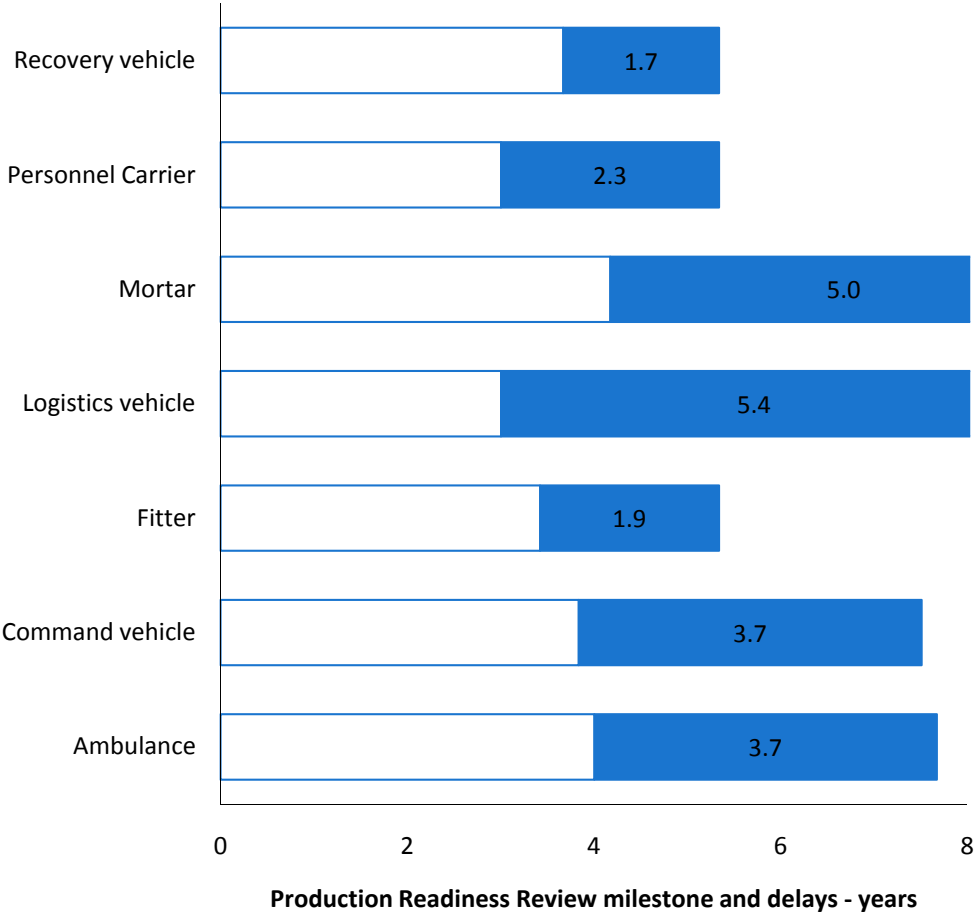
¹¹¹ Defence Materiel Organisation, *M113 Upgrade: Brief for Head Land Systems – Portfolio Budget Statements Budget Estimates Project Review*, November 2010.

¹¹² There have also been subsequent problems with vehicle brake systems that have caused the grounding of the M113 fleet for periods of time (see Chapter 5). Brake problems were a key technical issue during vehicle development, however this issue was considered resolved by Defence once the APC passed its PRR in November 2007.

large with their designs not finalised until April 2011 and September 2011 respectively. For these two variants and for the AA and the ACV, the delays have been aggravated by scope changes, including decisions to change the basic hull from which the upgraded variant will be produced. These changes were made primarily because the recommended gross vehicle mass of the unextended vehicles was found to be insufficient, and the original contract did not specify the payload to be carried by each vehicle.

Figure 2.4

Delays in achieving the Production Readiness Review milestone against the original 2002 schedule



Source: ANAO analysis of Defence data.

2.30 The overall impact of the unplanned design changes required for the ALV and the AM variants has been extended delays in delivering the complete family of upgraded vehicles to Army, with no ALV or AM vehicles delivered

to Army as at December 2011. Considered individually, each scope change may appear to be of a lesser impact than the cumulative effect of all of the scope changes, highlighting the importance of maintaining strong overall design management of the project.

2.31 A useful approach is to consider scope changes within the overall context of the project and its ultimate intention to deliver a major system in a timely fashion to enable the achievement of capability. As discussed in the 2008–09 audit, this entails considering the impact of scope changes on capability, as well as their financial impact.

2.32 At present, the required level of approval for a change of scope for a project in Defence is governed by the approval hierarchy set out in Table 2.2. The required level of authority to approve a change of scope for a major project, whether by the Minister or Cabinet, depends on the nature of the proposal and its likely cost.

Table 2.2

Defence capital expenditure approval authority

Total cost	Initiative Approval Authority
\$100 million and above	National Security Committee of Cabinet
\$20 million to \$100 million	Minister for Defence and the Minister for Finance and Deregulation ^(A)
\$8 million to \$20 million	Minister for Defence
Up to \$8 million	Departmental officials

Note: (A) The Prime Minister and Treasurer are advised by letter from the Minister for Defence of projects above \$20 million proposed for joint approval by the two Ministers.

Source: Department of Defence.

2.33 The 2008–09 ANAO report recommended that Defence set suitable threshold criteria for determining scope changes to allow decisions to be made

on scope changes, irrespective of the financial impact.¹¹³ Defence agreed to review the Defence Procurement Policy Manual (DPPM) and Defence and DMO Chief Executive Instructions and consider whether additional guidance was required. In the course of this audit, DMO informed the ANAO that it had addressed the ANAO recommendation through an updated DPPM, and a new Defence Materiel Instruction on *Mandatory Procurement Policy Requirements for Contract Changes*.

2.34 However, these amendments provide little advice on defining scope changes beyond the anticipated cost. This guidance, and other Defence documentation such as Joint Project Directives and the Defence Capability Development Handbook, note that scope changes may affect the capability originally sought, and highlight the need to engage with bodies such as Capability Development Group and the Capability Manager if capability changes affect the original project approval. However, this does not extend to documenting suitable threshold criteria for determining how significant changes in capability—including the timing of delivery and extent of capability to be delivered by a project—should be identified and considered for approval, irrespective of financial impact. In this context, Defence’s documented criteria remain focused on financial thresholds, and Defence has some way to go before it has addressed the recommendation made by the ANAO in March 2009.

¹¹³ Recommendation No.1, ANAO Audit Report No. 27 2008–09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, p. 57.

3. Monitoring cost and schedule

This chapter outlines the cost and schedule performance of the M113 upgrade project as a whole, including the whole-of-life costs of the project, costs of hull extension, and the cost and schedule performance of the Major Upgrade Contract.

Introduction

3.1 Managing the effective acquisition and development of major systems, such as the upgraded M113s, requires a combination of engineering, program management and commercial techniques in order to make best use of Defence's human and financial resources. As discussed at paragraph 2.7, a systems engineering framework was adopted for the development and manufacture of the upgraded M113s. This framework includes monitoring and managing the technical development and production of the upgraded vehicles, against cost and schedule.

3.2 At the time the last ANAO audit of this project was completed in March 2009, Defence was embarking on an ambitious program to recover the schedule for the production of the 350 upgraded M113s originally contracted for in 2002. Under the terms of the 2007 global settlement with the Prime Contractor, delivery of the last vehicle was still scheduled for December 2010, as specified in the 2002 Major Upgrade Contract. The recovery plan agreed between the parties following the 2007 global settlement involved the Prime Contractor running an additional production shift at its Bandiana production facilities. However, the Prime Contractor was unable to employ the additional staff to facilitate this, and consequently opened additional facilities at Williamstown in Victoria and Wingfield in South Australia, which were to be operated at no additional cost to the Commonwealth. The opening of additional facilities was noted as part of the Government's announcement of the approval to purchase a further 81 APCs.

3.3 As mentioned at paragraph 1.32, in June 2009, Defence informed the JCPAA that the project was a year behind schedule, and that completion of the first 350 vehicles by December 2010 was high-risk. Defence informed the Committee that it was working closely with the Prime Contractor in order to

deliver the upgraded vehicles, and noted that the contract included incentives for the Prime Contractor to meet the schedule.¹¹⁴

3.4 However, in the event, only 194 vehicles were completed by December 2010. By late 2010 Defence and the Prime Contractor were in preliminary discussions that led to another contract renegotiation, which formally began in February 2011. In August 2011, the parties finalised the amendment to the Major Upgrade Contract, which now provides for the final delivery of all 431 upgraded vehicles by December 2012. The details of the steps taken to recover the production schedule following the contract negotiations in 2007 and the further round of contract negotiations conducted in 2010 and 2011 are discussed in Chapter 4.

Whole-of-life costs

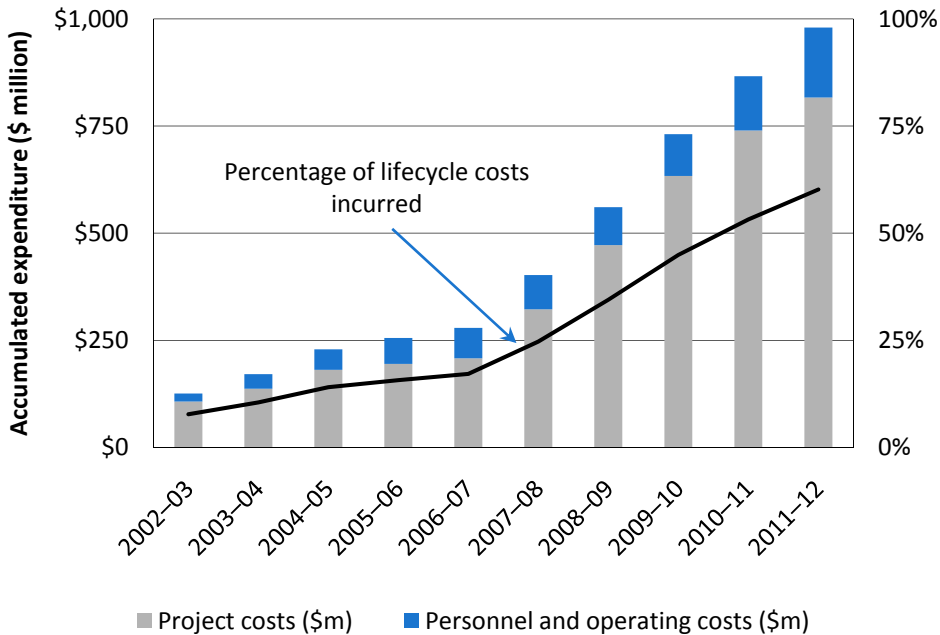
3.5 In addition to the up-front costs associated with the acquisition of military equipment, the cost of ADF capability also includes initial spares and support, and the personnel and operating costs associated with the use of the equipment over its life and the costs associated with retiring and disposing of the equipment.¹¹⁵ In aggregate these are referred to as the whole-of-life costs.

3.6 As at 30 June 2011, total expenditure on the upgrade of the M113 fleet, under both the Major Upgrade Contract and the CSP Contract, stood at \$739 million, and accumulated personnel and operating costs were estimated at \$127 million.¹¹⁶ As shown in Figure 3.1, by July 2012 the accumulated expenditure on upgrading and operating the upgraded M113s will approach \$1 billion, or some 60 per cent of the \$1.6 billion estimated whole-of-life cost for the fleet.

¹¹⁴ Joint Committee of Public Accounts and Audit, *Report 417: Review of the Auditor-General's Reports tabled between February 2009 and September 2009*, June 2010, p. 30.

¹¹⁵ Personnel and operating costs include staff costs and the cost of consumables such as fuel, ammunition and spare parts (see paragraph 3.9).

¹¹⁶ All financial figures in this chapter exclude GST.

Figure 3.1**Cumulative expenditure on upgrading and operating the M113 fleet, 2002–03 to 2011–12**

Source: ANAO analysis of Defence data.

3.7 The approved project budget for the M113 upgrade relates to capital expenditure: it does not include personnel and operating costs, or the costs associated with running the DMO Project Office and related support activities. However, transition funding is included within the project budget for initial spares procurement, support packages and initial training.

3.8 Personnel and operating costs in the Defence context are significant. For example, a February 2012 United States Government Accountability Office report stated that, in respect of the United States Department of Defense, operating and support costs have generally accounted for between 60 and 80 per cent of a weapon system's total cost.¹¹⁷

¹¹⁷ 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.

3.9 In the case of the upgraded M113 fleet, personnel and operating costs comprise the costs of maintaining and operating the upgraded and non-upgraded fleets.¹¹⁸ In addition to the costs of the personnel operating the M113 fleet, these costs include items such as fuel, ammunition, spare parts, maintenance services and supply services, as well as the costs of decommissioning the vehicles at the end of their life, currently scheduled for 2025. Defence currently estimates the total personnel and operating costs of the upgraded M113 fleet over the life of the upgraded vehicles at \$769 million (Budget 2010–11 out-turned price basis)¹¹⁹, amounting to close to 50 per cent of the estimated whole-of-life cycle cost of \$1.6 billion for the upgraded fleet.

3.10 As noted in paragraph 3.7, DMO Project Office costs (staffing and associated costs) related to individual projects are not included in a project's budget and are not directly captured by Defence's financial systems. In November 2011, Defence estimated that the accumulated personnel costs associated with the major upgrade project staff amounted to some \$40 million since 2002. In 2002, Defence had advised government that it estimated the net impact on the personnel and operating costs of the M113 fleet would be cost-neutral under the original 2002 Major Upgrade Contract, which provided for the upgrade of 350 vehicles. While the 350 upgraded vehicles were to be brought into service, the total fleet of M113s was to be reduced by more than half—from 767 M113A1 vehicles to 350 M113A4s.¹²⁰

3.11 However, since the 2008–09 ANAO audit, estimates of personnel and operating costs for the upgraded M113 fleet have increased, largely on the basis of improved information about the likely and actual costs of operating the vehicles. For example, work done in 2008, as part of the process to obtain government approval for the additional 81 APCs procured as part of the ELF initiative, involved the development of personnel and operating cost estimates based on more rigorous information than had been required when government

¹¹⁸ That is, the costs of operating the un-upgraded M113s from 2002–03 until their withdrawal from service. Defence advised ANAO in March 2012 that this withdrawal was completed in June 2010.

¹¹⁹ Out-turned prices include the estimated impact of future inflation over the period funds are to be expended. All DMO capital projects have their total project budget managed in out-turned budgets, and all costings provided by Defence in submissions to government are required to be on an out-turned basis.

¹²⁰ Similarly, Defence assessed the 2009 decision to extend the AM variant as having a cost-neutral impact on personnel and operating costs.

originally approved the major upgrade in 2001.¹²¹ The resulting estimate provided to government was that the additional 81 ELF vehicles would incur a further estimated \$99 million in personnel and operating costs over the life of those vehicles.¹²²

3.12 In addition, given that upgraded M113s have been progressively issued to Army since November 2007, Defence now also has a better understanding of M113 in-service support costs. This has led to increases in current estimates of the cost of spare parts, maintenance and supply services. In this context, a 2010 Defence review of the personnel and operating costs related to the 81 ELF APCs found that the key risk to future personnel and operating costs was:

an increase in maintenance costs through lower than tested and expected reliability performance of the upgraded M113s.

3.13 As a result of this better information, Defence has revised upwards its estimates of the personnel and operating costs associated with the upgraded M113 fleet:

- For the original 350 vehicles, Defence estimated that the personnel and operating costs would increase by \$82.3 million, to \$561.1 million (Budget 2010–11 out-turned price basis) over the life of the vehicles.
- For the extra 81 ELF APCs, the estimated personnel and operating costs over the life of the vehicles have increased from the original 2008 estimate of \$99 million (Budget 2008–09 prices) to \$110.7 million (Budget 2010–11 out-turned price basis).
- Defence currently estimates the total personnel and operating costs of operating M113s (both upgraded and unupgraded) from 2002–03 to 2026–27 at \$769.2 million (Budget 2010–11 out-turned price basis). Approximately \$689 million of this can be attributed solely to the

¹²¹ Defence was required to estimate the personnel and operating costs using a two-pass approval template incorporating a series of parameters (inflation, exchange rates, user groups and locations), guidance (advice from Defence groups where required) and assumptions (for example estimated rates of effort of the vehicle) for the individual items such as fuel, maintenance services and other items.

¹²² See page 47 of Audit Report No.27 2008–09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*. The estimated \$99 million in personnel and operating costs (\$1.2 million for each vehicle) is in addition to the Government-approved \$221 million for the purchase of the 81 vehicles (\$2.7 million each), bringing the total whole-of-life costs of these additional vehicles to \$320 million (more than \$3.9 million each).

upgraded M113 fleet (excluding costs of operating the old A1 fleet)—an average of \$1.6 million per upgraded vehicle.¹²³

M113 Commercial Support Program funding and costs

3.14 In December 1997, the Prime Contractor and Defence signed the Commercial Support Program (CSP) Contract, for the maintenance of ADF vehicles, including armoured vehicles. Work conducted under this contract is funded through Army equipment sustainment funding. It includes the stripping, repair, extension and painting of the M113 hulls for the original 350 vehicles in the upgrade project, after which the cost of vehicle assembly is met under the Major Upgrade Contract.

3.15 As CSP funding for sustaining Army equipment is set independently from the Land 106 M113 upgrade project, changes can occur in CSP funding that can affect the flow of hulls into the M113 upgrade assembly line. DMO first recorded this risk in April 2009 and the project's April 2010 risk log recorded that there was uncertainty that Army would fund hull conversion in 2010–11, because of sustainment pressures from other fleets of Army vehicles. The consequence identified for this risk was a slowing of schedule recovery and delay in project closure, with an 'almost certain' likelihood and 'severe' impact on schedule. The mitigation strategies mooted included seeking a project scope change in order to draw on project contingency funds (including ELF contingency funds) to fund the extension of hulls and thereby avoid delaying production. The fallback plan was to reduce production rates in accordance with available CSP funding.

3.16 In the event, DMO reordered the sequence of production for upgrading the vehicles to bring forward to 2010–11 the production of the additional 81 ELF vehicles, which were originally scheduled to be produced last. In this way, hull preparation and extension could be funded from the Land 106 M113 major upgrade project, as the project's budget includes funding for the preparation and extension of the 81 ELF APCs, whereas funding for this for all other vehicles is only available through Army's sustainment budget. This has

¹²³ Up until 2008, personnel and operating costs reduced in line with the wind down of the M113A1 fleet and the delayed roll out of the upgraded fleet. Between 2008 and 2010, costs remained flat as the number of upgraded vehicles and their usage remained low, and the M113 Major Upgrade Contract covered the costs of most maintenance and spares.

reordered vehicle delivery, and defers sustainment costs to be funded by Army.

3.17 In an attempt to mitigate the risk of late vehicle deliveries, Director General Land Manoeuvre Systems (DGLMS) wrote to the Commander of Joint Logistics Unit–Victoria (JLU(V)) on 19 August 2011, requesting JLU(V) spend more money on M113 related CSP work to mitigate potential delays to vehicle delivery by December 2012. The letter included an offer to provide Army with funding from the upgrade project to facilitate this. DGLMS stated in this correspondence that:

The DMO cannot emphasise enough the importance to Defence of achieving force preparation objectives for the [*upgraded M113*] platform.

3.18 DMO informed ANAO in March 2012 that, in the event, JLU(V) has not required supplementation from the upgrade project's budget to support hull conversion work, as CSP funding is adequate to finish the last of the hull conversion work.

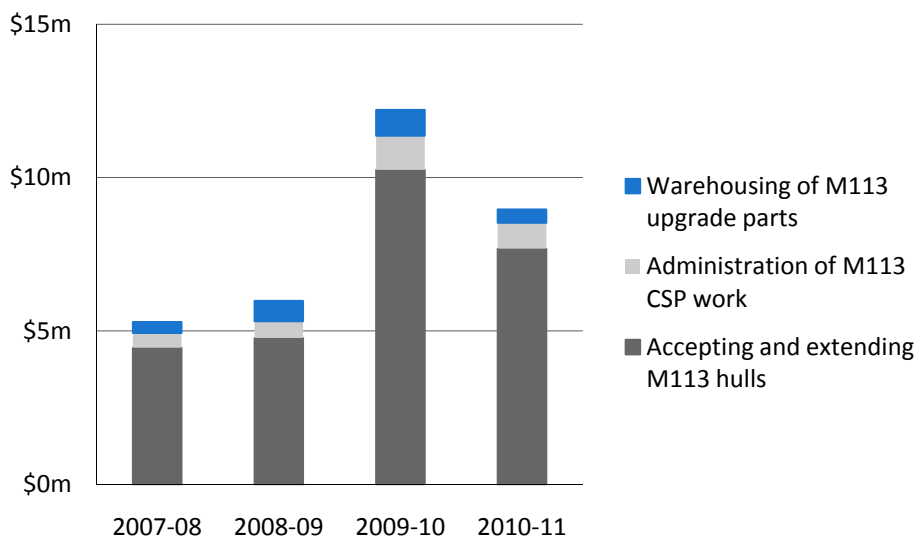
CSP costs related to the upgrade of the M113s

3.19 There are two stages in the M113 hull conversion process: hull acceptance and hull extension. Hull acceptance involves inspecting hulls to confirm they are suitable, and then preparing them for extension. Hull extension involves cutting the prepared hull and welding in the pre-fabricated extension kit: this work incurs the bulk of the CSP M113 costs.¹²⁴ Up to December 2010, work on accepting and extending M113 hulls had cost an estimated \$32.43 million under the CSP Contract, with figures for the four years 2007–08 to 2010–11 shown in Figure 3.2. This figure was determined by ANAO during audit fieldwork, and Defence was unable to provide ANAO with updated figures.

¹²⁴ For simplicity, both these stages are collectively referred to as hull extension in this report, as hull extension is the main component of CSP work.

Figure 3.2

M113 costs under the Commercial Support Program contract, 2007–08 to 2010–11 (as at December 2010)



Note: 2010–11 data is for July to December 2010 only.

Source: ANAO analysis of Defence data.

Managing the hull acceptance and conversion process

3.20 The DMO fleet manager for the M113s¹²⁵ determines the validity of the Prime Contractor's quotes or proposed variations for work on M113 hulls. The M113 fleet manager exercises this authority through the M113 Material Review Board (MRB).¹²⁶ The MRB is chaired by the Prime Contractor and includes attendees from DMO and JLU(V). The Board inspects stripped M113 hulls and determines whether it is feasible to upgrade them.¹²⁷ Technical decisions on hull work are made by the Prime Contractor, in consultation with Project Office engineering staff, with Defence making decisions on economic viability based on the quotes supplied.

¹²⁵ Fleet management is the process used within Joint Logistics Command to control and manage Army materiel. A system of national fleet managers and regional fleet managers exists to cover the major fleet groupings, which incorporates weapons systems such as M113s.

¹²⁶ The Board was formally established in May 2010, although it had been meeting since May 2009.

¹²⁷ Approval by the MRB does not guarantee that a hull will enter the upgrade program; it may be rejected on economic grounds by JLU(V) or be set aside by the Prime Contractor if the hull requires extensive repairs.

3.21 The MRB completed its certification work in December 2011, rejecting a total of 26 hulls as unusable. In 2010, hulls were being set aside due to hull delamination cracking until such time as the Prime Contractor's lamination repair scheme was approved by the Defence Science and Technology Organisation (DSTO).¹²⁸ DSTO approved the scheme, with some amendments, in August 2010, though the additional repairs add to the work required to prepare affected hulls for extension.¹²⁹ Defence advised ANAO in March 2012 that most hulls required laminar repair. ANAO examined records relating to a sample of 138 inspected hulls. Of these hulls, 119 had laminar cracking, with the required repair time ranging from two hours to 126 hours.

3.22 Work conducted may be covered by standard repair prices (SRPs) included in the CSP Contract. SRPs cover labour prices, repair parts and consumables purchased by the operator, and any overhead costs not otherwise reimbursed. Where SRPs are not available, a survey and quote process is applied using contracted rates to determine the cost of upcoming work. For M113 work, there are SRPs for hull acceptance and extension of APC hulls.¹³⁰

3.23 The cost of extending the hulls varies from hull to hull according to the number of hours of work required, and some hulls may require more expensive additional trade repair work to be conducted off-site. Defence informed the ANAO that the quality of hull stock varies, and the ANAO observed that, as the stock of hulls has been worked through, latter hulls have required more preparation prior to extension.¹³¹ This is consistent with Defence's June 2010 assessment that hull remediation requirements had increased. As the initial stock of good quality hulls is expended, hull preparation becomes more demanding as hulls of progressively lesser quality are used. The unit costs of hull extension are shown in Figure 3.3.

¹²⁸ Aluminium and other metals can develop 'onion skin' fractures, where the metal fractures in layers through its depth. This type of fracturing is commonly called a lamination fracture, in which layers of sound metal are separated by corrosion products and voids.

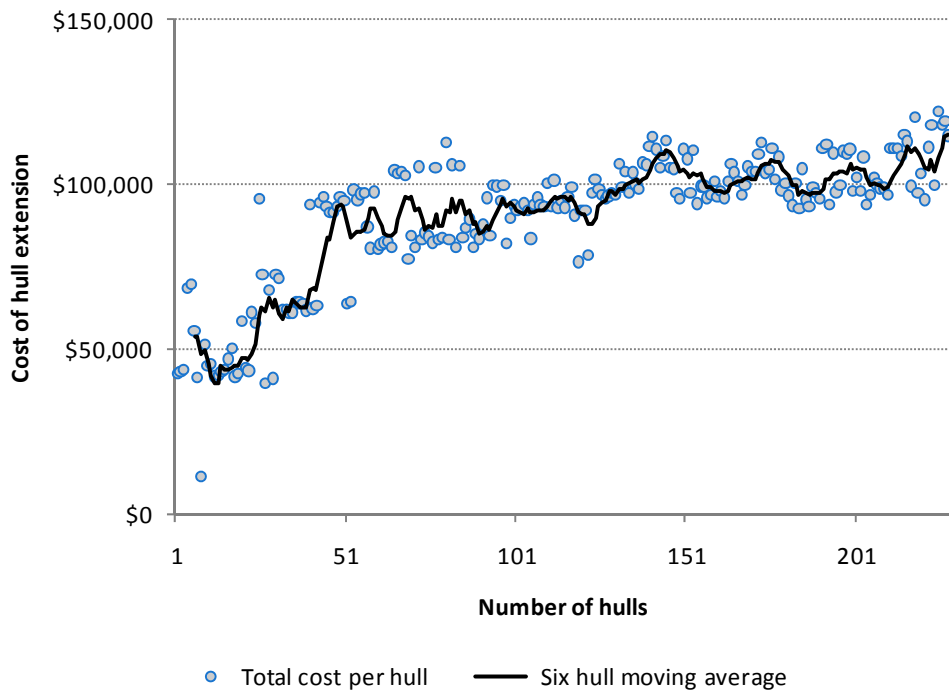
¹²⁹ DSTO's review of the repair techniques emphasised the need to minimise the size of weld deposits (to reduce the loss of ballistic protection), and to place welds in specific locations (to minimise risk of further delamination).

¹³⁰ There are no SRPs for hull acceptance and conversion for the ACV, AA, ALV and AM variants. Work performed on these hulls is done based on both the APC SRP and survey and quote work, with the latter covering variant specific work.

¹³¹ This contrasts with Defence's 2008 submission to government seeking approval of the upgrade of the additional 81 ELF vehicles which stated that 'there is no evidence to suggest the quality of available hulls will change over the life of this project'.

Figure 3.3

Unit costs of extending hulls



Source: ANAO analysis of Defence information.

3.24 The data in Figure 3.3 indicate that the costs of hull extension did not stabilise until after the first 40 were processed, indicating the number of iterations necessary to properly develop the necessary production techniques and systems. This stabilisation occurred early in 2009, over a year after agreement was reached to go to full production. Since then, the average number of hours worked on each hull has been in the order of 2200 for an average cost of approximately \$96 000, almost double that estimated at the beginning of the production process.

3.25 When commenting on analysis of schedule delays in projects being reviewed, ANAO Report No.20 2011–12, *Major Projects Report*, noted that: ‘the reasons for schedule slippage vary, but primarily reflect the underestimation of both the scope and complexity of work by industry and the Defence

Organisation'.¹³² The systems engineering process applied to the M113 project has been underdeveloped. This has manifested itself in:

- prolonged development and design processes for the variants (as discussed in chapter 2);
- delays in hull extension work, as the work required under the CSP Contract has taken longer than planned, with an associated additional cost that is uncapped because payment is made depending on the actual hours it takes to repair, prepare and extend each hull;
- insufficient assembly capacity, with the limitations of the Bandiana facility noted at the time of the 2008–09 audit; and
- substantial re-work of hulls being required, which has also slowed vehicle acceptance.

3.26 Hull extension and assembly delays have also been caused by the non-uniformity of hull sizes and builds. As noted in the previous audit, this means assembly more closely resembles a jobbing shop rather than a production line, with a corresponding lower rate of production. Limited improvements to the Bandiana facilities, and the opening of additional facilities in Wingfield and Williamstown (see paragraph 3.66), slowed schedule slippage. However, vehicle production rates were inadequate to recover schedule, resulting in the August 2011 agreement between Defence and the Prime Contractor for an extension to the final vehicle delivery date under the Major Upgrade Contract, to December 2012.

3.27 The major upgrade project was established in a way that makes it substantially reliant on another program, the CSP, which is separately funded from Army sustainment funding. The extent of this reliance was not appreciated at the commencement of the major upgrade in 2002. In large part this was because the scale and complexity of the work to be conducted under the CSP was expected to be much less than has actually been required. As design issues have emerged over the course of the project, scope changes have been approved for the extension of the ARVL, AA, ACV and AM variants, meaning an additional 91 vehicles required extension. Funding pressures in the CSP Contract have been a high risk for the completion of the M113 upgrade project, although Defence informed ANAO in March 2012 that sufficient CSP

¹³² ANAO, Report No.20 2011–12, *Major Projects Report*, p. 23.

funds exist to complete hull extension work. In 2010–11 the production of the ELF vehicles was brought forward to fill a CSP funding shortfall, as the Land 106 major upgrade project budget includes funds to extend the 81 ELF vehicles.

Major upgrade project budget and expenditure

3.28 The approved project budget for the upgrade project, as at December 2010, stood at \$885 million (2010–11 dollars), compared to \$624.2 million (2007–08 dollars) at the time of the 2008–09 audit. Table 3.1 shows the combined impact of indexation and scope changes on the project budget over the life of the project,¹³³ and shows yearly progress in spending the project budget and accepting vehicles.

3.29 However, the majority of the increase in the project budget since global settlement negotiations were concluded in October 2007 has been due to the two major scope changes that have occurred since then:

- in October 2008, the Government approved the upgrade of an additional 81 APCs under the Enhanced Land Force (ELF) initiative. The total cost of this scope change was \$222.1 million (2008–09 budget prices),¹³⁴ and
- in July 2009, the Government approved the extension of the 21 AMs at a cost of \$17.1 million (2009–10 budget prices).¹³⁵

¹³³ The total budget for the project is adjusted annually in accordance with the parameters announced in the Budget. In addition, the Major Upgrade Contract provides for indexation to maintain the purchasing power of the original contract amounts, which were set in November 2001 dollars.

¹³⁴ See the section commencing at paragraph 3.31 for further information about this scope change.

¹³⁵ The issues surrounding the decision to extend the AM variant are discussed in more detail in Chapter 2 of this report.

Table 3.1**M113 upgrade project expenditure and deliveries, 2002–03 to 2010–11**

Financial year	Total approved project budget (\$million)	Project expenditure to end of financial year (\$million)	Vehicles accepted ^(A)
2002–03	550	107	0
2003–04	566	138	0
2004–05	589	182	3
2005–06	594	195	7
2006–07	617	208	8
2007–08	624	317	31
2008–09	911	461	75
2009–10	889	610	145
2010–11	885	698	260

Note A: Includes 14 Initial Production Vehicles, most of which were accepted between October 2004 and May 2006. These vehicles will need additional work to bring them to a Production Vehicle standard. Defence advised the ANAO that this work is being managed and funded by the M113 major upgrade project (not the CSP), and is being carried out at the Wingfield site in Adelaide.

Some figures may not add due to rounding.

Source: Defence Materiel Organisation Annual Reports, 2010–11 Budget Statements and ANAO analysis of vehicle acceptance data.

3.30 In most financial years there have been substantial variations between annual budgeted and actual project expenditure. For instance, actual expenditure in 2005–06 and 2006–07 was less than planned due to technical difficulties that delayed progress and resulted in DMO withholding payments to the Prime Contractor.¹³⁶ Since then, annual expenditure has exceeded, or been close to, initial budget estimates. However, planned expenditure in 2008–09 and 2009–10 was achieved despite considerable schedule slippage (see paragraphs 3.39 to 3.44).

Enhanced Land Force (ELF) initiative

3.31 In August 2006, the then Government approved stage 1 of the Enhanced Land Force (ELF) initiative, designed to provide an increase in land force capacity to assist the ADF sustain multiple operations. At the time, the

¹³⁶ These issues were addressed as part of global settlement negotiations that concluded in October 2007. See ANAO Audit Report No. 27 2008–09 *Management of the M113 Armoured Personnel Carrier Upgrade Project*, pp. 81–87.

ADF had only one mechanised infantry battalion. Under ELF, Defence planned to acquire, amongst other things, additional Bushmaster vehicles and upgraded M113s to equip a new mechanised battalion.¹³⁷ Defence estimated that the resulting additional costs to the M113 major upgrade project would be \$242.4 million in 2010–11. No specific number of vehicles was mentioned.

3.32 In December 2006, Defence proposed improvements to the ELF initiative through the upgrading of an additional 54 M113 APCs—in addition to the unspecified number of vehicles from the August 2006 submission—to ensure that 1 Brigade was fully mechanised, and that 5 RAR and 7 RAR would be equipped solely with M113s, eliminating the inefficiency of operating mixed fleets of M113s and Bushmasters. Government did not agree to this proposal.

3.33 In October 2008, Defence proposed acquiring 81 upgraded M113 armoured personnel carriers (APCs), in addition to the 350 upgraded M113s being sourced under the M113 Major Upgrade Contract, as part of implementing the ELF. Defence's proposal was predicated on:

- the December 2006 agreement of the previous Government to set aside funding under the ELF initiative for 81 upgraded APCs;
- decreasing the risks to soldiers deployed on operations by making more protected vehicles available, and by providing greater operations flexibility to commanders in the field by increasing the protection, mobility and lethality of mechanised force elements;
- its assessment that the 350 vehicles to be delivered under the original Major Upgrade Contract were insufficient to fully equip the two mechanised battalions;
- the additional APCs allowing Bushmasters to be removed from 1 Brigade while fully equipping the two mechanised battalions (5 and 7 RAR) with M113s;¹³⁸

¹³⁷ At the time of the submission to Cabinet, 5/7RAR was the sole mechanised battalion in the ADF. Subsequently, with the procurement of additional Bushmasters and upgraded M113s, 5/7 RAR was to be split into two battalions, 5 RAR and 7 RAR. The two separate battalions were established on 3 December 2006.

¹³⁸ Defence's advice to the Government in December 2006 was that an additional 54—in addition to the unspecified number of vehicles from the August 2006 submission—were required to fully equip 5 RAR and 7 RAR with M113s.

- an estimated cost of \$222.1 million (Budget 2008–09 out-turned prices),¹³⁹ including hull extension work and three years of spares. The additional personnel and operating costs were estimated as \$99 million for the life of type of the vehicles to 2025; and
- the delivery of the additional 81 vehicles by July 2011.

3.34 Defence advised the Government in its October 2008 submission that acquiring the 81 ELF vehicles through the Major Upgrade Contract, rather than under a separate contract, would avoid further cost increases and a 6 to 12 month delay in delivering the vehicles to operational units (beyond the July 2011 due date for all vehicles advised in the submission). Government was also advised that the Chief Defence Scientist and the Chief Executive Officer of DMO agreed with the cost and schedule risk-mitigation aspects of the submission. In the event, when the contract was amended to include these additional vehicles, the due date had shifted to November 2011.

3.35 The Major Upgrade Contract included a provision granting the Commonwealth the right to purchase up to 104 additional APCs at a unit cost of approximately \$1.1 million (October 2001 base-date dollars), compared to the \$2.74 million unit cost under the \$222.1 million ELF decision (Budget 2008–09 out turned prices). However, the contract terms were ambiguous: while they allowed the Commonwealth to exercise this option at any time prior to August 2010, the relevant contract attachment setting out unit costs extinguished the option from August 2005. The contractual terms and conditions note that, where there is any inconsistency between parts of the Contract, the terms and conditions and glossary have precedence over all attachments. Defence was unable to provide ANAO with any legal advice it had obtained on this option, or any evidence of consideration by senior decision makers relating to potentially exercising it. DMO informed ANAO in March 2012 that:

It would appear that the option was considered extinguished from Aug 2005. It should be noted that the ELF Stage 1 submission was agreed by the previous Government in Dec 2006, which was well after the Aug 2005. The resetting of the contract via global settlement in 2007 superseded previous versions of the contract.

¹³⁹ The total costing for the 81 ELF vehicles presented to government included a mobilisation payment of \$26–\$30 million to the Prime Contractor and a \$35.1 million contingency. See section beginning paragraph 3.49 for discussion of the ELF mobilisation payment.

3.36 ANAO notes that the relevant terms and conditions allowing purchase of additional vehicles prior to August 2010 remained in the contract following the 2007 global settlement.

Monitoring cost and schedule

3.37 The Major Upgrade Contract requires the Prime Contractor to provide monthly Cost Schedule Status Reporting (CSSR) to DMO. The objective of CSSR is to:

satisfy Department of Defence cost schedule performance information needs with earned value based data of known validity extracted from the same data base employed by the Prime Contractor for internal performance management.¹⁴⁰

3.38 CSSR reports are intended to be a key source of data allowing the project authority to evaluate the Prime Contractor's cost and schedule performance. The M113 Major Upgrade Contract provides that the cost to the Commonwealth of the provision of CSSR reports and management of the Prime Contractor's CSSR system over the life of the contract will total \$5.2 million (October 2001 base-date dollars).

3.39 The ANAO analysed the CSSR system reports on the M113 upgrade project from January 2008 to May 2011 to identify budget performance and examine variances between actual and planned project expenditure (see Figure 3.4). This analysis indicates that from October 2007 (the time of the global settlement) to January 2010, the Prime Contractor's monthly budgeted price for work performed was largely similar or higher than the actual price of work performed.

3.40 However, during this time the project schedule was experiencing considerable slippage. The blue schedule variance line tracks the accumulated deviation in the schedule performance (expressed as a price)¹⁴¹ in relation to the 2007 global settlement schedule, and the schedule advised by Defence at the conclusion of the 2008–09 audit. It shows that, from early 2009, actual

¹⁴⁰ Department of Defence, *Def(Aust)5658 Cost Schedule Status Reporting (CSSR) Specification Implementation Guide; Standard*, 1994, p. 3.

¹⁴¹ CSSR for the M113 project is based upon 'price' rather than 'cost'. Cost is the direct expense incurred for delivering a work package, while price is what the Commonwealth is paying for the work package. Price will include a rate of profit, and price is the basis of the deliverables listed in the contract's work breakdown structure.

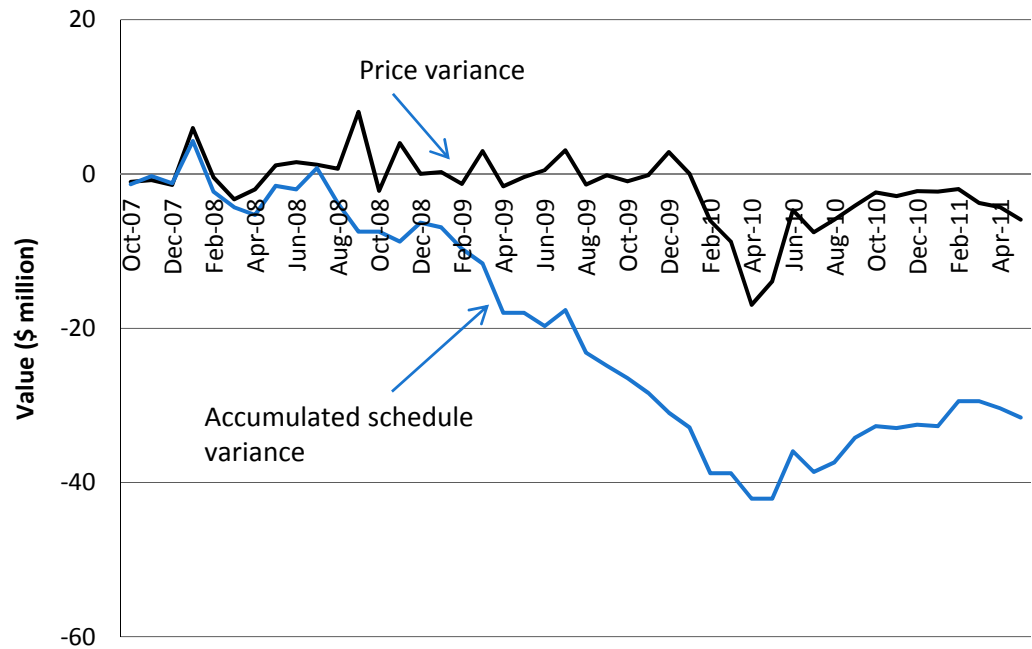
schedule performance began slipping significantly behind the performance that would otherwise be indicated by the level of expenditure.

3.41 Figure 3.4 shows more than a year of continual schedule performance decline, reaching a low point in April 2010. At that time, approximately \$42 million of scheduled work had not been delivered against the 2007 global settlement schedule.¹⁴²

3.42 DMO was not able to provide any evidence that it analysed the data provided in the monthly CSSR reports. In contrast to the analysis set out in Figure 3.4, DMO’s April 2010 Acquisition Overview Report reported schedule performance for the project as green (see paragraph 4.53 for discussion of project reporting through Acquisition Overview Reports).

Figure 3.4

M113 major upgrade project price and schedule variance trends



Note: Work conducted under the CSP Contract is not included in this figure, as it is not performed under the Major Upgrade Contract.

Source: ANAO analysis of Defence documentation.

¹⁴² If schedule variance is measured against subsequent rebaselined contracts, which includes those for the additional 81 vehicles and the extension of the mortar variant, the low point of schedule slippage would be February 2010, with \$30 million of scheduled work not being delivered.

3.43 The CSSR data also indicate some recovery of schedule performance from April 2010, which may reflect additional investment by the Prime Contractor in setting up and operating additional facilities at no extra cost, and the associated increase in vehicle production. Since November 2010, vehicle acceptance rates have averaged 12 per month.

3.44 However, the CSSR data indicate expenditure without the achievement of schedule since late 2008, which may be attributed to a range of factors, including higher contracted unit costs for ELF vehicles (which were being produced in 2011, earlier than scheduled), and, particularly, the purchase of long lead-time items in advance of need (see paragraph 3.59).

ELF unit costs

3.45 When seeking the Government's approval of the additional 81 ELF vehicles in 2008, Defence's estimate of the unit cost for each ELF APC was \$2.34 million per vehicle. Defence's calculations stated that this ELF unit cost was the same as similarly equipped APCs being procured as part of the 2002 Major Upgrade Contract when the following was taken into account:

- the 81 ELF vehicles are all the APC variant, which Defence indicated was the most expensive of the M113 fleet variants;¹⁴³
- all 81 ELF APCs are to be equipped with armour (vehicle and turret appliqué armour), whereas only 88 of the 167 APCs to be produced under the Major Upgrade Contract would be equipped with both; and
- the provision of in-service support at two locations and for three years for the 81 ELF vehicles, compared to the one year's support in one location provided for under the Major Upgrade Contract.

3.46 However, the cost of contract milestones for the ELF vehicles shows some marked differences in price when compared to the same contract milestones for the original 350 vehicles. Suspension systems are almost 40 per cent cheaper for the ELF vehicles and a small number of items are the same price—for example armour and some management milestones. However, the price of several ELF APC contractual milestones is much higher than the same milestones for the 167 originally contracted APCs.

¹⁴³ The most expensive vehicles among the original 350 ordered are the AMs which are expected to cost \$2.1 million per unit.

3.47 ANAO analysis indicates that, overall, ELF APC vehicle parts will cost approximately \$9.7 million (12 per cent) more than those for a similar number of the originally contracted APCs. Project management milestones for the extra vehicles will in total cost \$1.7 million (37 per cent) extra than for the same milestones under the original contract. Table 3.2 illustrates some large discrepancies. Overall, comparing the cost of upgrading the 81 ELF APCs against 81 originally contracted APCs to the same standard, ANAO analysis indicates that the ELF vehicles are approximately \$11.4 million (2001 base date dollars) more expensive, despite being produced on the same production line.

3.48 DMO data on production costs from December 2010 to November 2011 shows that the average production cost of non-ELF APCs was \$1.5 million, while the average cost of production for ELF APCs was \$1.9 million.

Table 3.2**Significant variances in contract milestone costs for ELF and non-ELF vehicles**

Contract milestones	Cost per unit for non-ELF vehicles	Cost per unit for ELF vehicles	Percentage and total cost increase for 81 ELF APCs compared to 81 original APCs
External fuel tanks (for all vehicles except ALV & ARVL)	\$5 000	\$16 000	218% (\$0.834 million)
Turret slewing ring (APC specific)	\$24 000	\$42 000	70% (\$1.390 million)
Vehicle assembly (APC specific)	\$22 000	\$32 000	47% (\$0.830 million)
Vehicle materials (APC specific)	\$74 000	\$101 000	36% (\$2.166 million)
Turret sight (APC specific)	\$42 000	\$53 000	24% (\$0.823 million)
Engineering Management	\$45 000 (occurs 49 times, last in November 2007)	\$73 000 (per month from January–December 2011 to coincide with scheduled ELF vehicle production)	229% (\$0.607 million)
Production Management (monthly management)	\$93 000 (per month up to contracted completion date of December 2010)	\$183 000 (per month from January–December 2011 to coincide with scheduled ELF vehicle production)	97% (\$1.080 million)

Note: Figures may not add due to rounding.

Source: ANAO analysis of Defence information.

ELF prepayment

3.49 Several mobilisation payments (prepayments) have been made to the Prime Contractor in connection with the upgrade of the M113s, totalling some \$100.4 million. This compares to the current Major Upgrade Contract value of \$512.5 million (October 2001 base-date dollars). A prepayment of \$4.21 million (December 1996 base-date dollars) was also paid to the Prime Contractor in May 1997 under the terms of the original contract for a minor upgrade of the

M113.¹⁴⁴ Defence informed the ANAO in the course of the 2008–09 audit that it had recovered the full amount of this advance by November 2005.¹⁴⁵

3.50 At contract signature in July 2002, the Major Upgrade Contract provided for two \$40 million prepayments to be made to the Prime Contractor. The first was payable and made on contract signature and the second prepayment of \$40 million was payable upon successful completion of the APC Production Readiness Review, which occurred in November 2007. A further prepayment of \$16.2 million (October 2001 base-date dollars) was paid to the Prime Contractor in January 2009 in relation to the ELF vehicles. Each prepayment was to be amortised across the remaining life of the upgrade contract at the point of payment. For example, the ELF prepayment is to be amortised across all the ELF-related deliverables, incorporating ELF equipment, management and reporting. As at the end of November 2011 the prepayments had been almost completely defrayed:

- approximately \$2.3 million remained to be defrayed against the first two prepayments; and
- approximately \$1.3 million remained to be defrayed against the ELF prepayment.

3.51 Prepayments are commonly made to a contractor so that they have the cash to purchase items and to pay subcontractors to produce items, particularly those with long lead-time items, necessary for a project. Prepayments reduce the Prime Contractor's costs of financing such purchases by (for instance) raising a loan on its own account. Where a contractor bears the financing costs, these are usually passed on to the purchaser as an increase in contract price.

3.52 The 2008–09 audit report recommended that Defence develop clear policy guidance on utilising mobilisation payments, and that appropriate records be maintained of the rationale underpinning any decision to include a prepayment in a contract. In response, Defence included additional advice to drafters in updating the 'Core Considerations of the Higher Delegate Submission—Contract Approval template'. This is intended to lead to a record

¹⁴⁴ Phase 1(a) M113 Upgrade Contract.

¹⁴⁵ The 2005–06 Audit Report had identified that, at that time, only \$970 000 of the \$4.21 million prepayment had been offset against deliverables in the contract and that the remaining amount of \$3.24 million was a debt owing to the Commonwealth. Accordingly, Recommendation No.3 of that audit report was that DMO recover against deliverables, the outstanding amount of this mobilisation payment.

of the contract approver explicitly considering the use of a mobilisation payment. The pertinent advice states:

Does the contract include a mobilisation payment? If so, the mobilisation payment must be justified. Consideration should be given to any impact the mobilisation payment has on value for money. Outline the reasons for agreeing to a mobilisation payment in the contract, and if available include advice obtained from Financial Investigation Services.

3.53 Defence's detailed comments in response to the previous audit's recommendation also quoted the existing Defence Procurement Policy Manual.¹⁴⁶

A mobilisation payment should only be paid under a contract where the Prime Contractor or its subcontractors will incur significant non-recurring ramp-up costs, including the cost of procuring plant, machinery, materials and facilities for use in the production of the supplies. A mobilisation payment will not usually be required for commercial-off-the-shelf acquisitions or procurements off a well established production line where only minor modifications to the products are required.

Only one mobilisation payment should be paid to the Prime Contractor under a contract. Mobilisation payments will usually be for between 5–15 per cent of the contract price. Consideration should be given to the entire payment regime for the contract when determining an appropriate amount for the mobilisation payment.

3.54 Defence considered that the revised Contract Approval template addressed the relevant recommendation of the 2008–09 ANAO report, including by requiring consideration of the impact of any such payment on value for money and the maintenance of appropriate records of the basis for any decision to make a mobilisation payment.

3.55 As stated in paragraph 3.50, the ELF mobilisation payment is scheduled to be amortised across all the ELF-related deliverables, incorporating ELF equipment, management and reporting. However, the ELF vehicles (all APCs) are being built using an existing, well-established production line, where APCs are the most produced variant. In addition, spreading the amortisation of the ELF prepayment across various management deliverables does not accord with the current guidance in the Defence Procurement Policy Manual that

¹⁴⁶ The Manual is 'the primary reference document for all Defence officials involved in the procurement process'.

mobilisation payments should be used for 'significant non-recurring ramp-up costs'.

3.56 In order to contract for the additional 81 ELF APCs, Defence has used an amendment to the existing major upgrade contract, under which the Prime Contractor has already received two mobilisation payments that will not be completely defrayed until the delivery of the last non-ELF vehicle.

3.57 Defence provided ANAO with evidence showing that the DMO Financial Investigation Service analysed the proposed cost of the relevant contract change proposal. This analysis stated that the Prime Contractor's basis for requiring a mobilisation payment was that there would be a period of negative cash flow during ELF vehicle production, and that the Prime Contractor argued that the proposed price of the contract amendment was based on receiving a mobilisation payment.¹⁴⁷ Defence also informed ANAO in March 2012 that the prepayment was made to allow the Prime Contractor to order expensive long lead time items.

3.58 However, ANAO notes that:

- the Prime Contractor had already received two large mobilisation payments under the Major Upgrade Contract;
- the ELF mobilisation payment is being defrayed across all additional ELF milestones, not just for purchase of long lead time items; and
- in the event, the production order of vehicles was altered, with ELF APCs produced earlier than originally intended, prior to the completion of the originally contracted vehicles.

Advance purchase of long lead-time items

3.59 By the end of 2009–10, the majority (69 per cent) of project funds had been expended while only one-third (34 per cent) of vehicles had been accepted (147 of 431). The disparity between vehicle numbers and total cost is explained in part by DMO's advance purchase of large quantities of vehicle component parts and sub-assemblies, which are then warehoused well ahead of their likely need on the M113 assembly line. These include engines and

¹⁴⁷ The Financial Investigation Service ultimately supported a mobilisation payment lower than that originally sought by the Prime Contractor, but higher than that originally proposed by the Financial Investigation Service. ANAO received an email from DMO confirming the Financial Investigation Service's position, however did not receive the requested evidence and analysis used as the basis for their decision.

transmissions (the drive system), hull extension kits, armour and turrets. Many of these items are delivered from overseas project sub-contractors. The drive system is the most expensive sub-assembly, costing approximately \$0.5 million per vehicle.

3.60 In each year from 2007–08 to date, DMO has made a practice of early acceptance and payment for long lead-time vehicle components and sub-assemblies. The advantage is that, over this time, there has been minimal delay to vehicle assembly caused by lack of parts and components.

3.61 However, this has not been the sole rationale for the advance purchase of parts and components. In 2010–11, the M113 Project Office advised Head Land Systems that spare part and sub-assembly deliveries would be brought forward to avoid underspending the annual budget for the project. ANAO inspected the M113 warehouse at Bandiana in September 2011 and found 102 drive systems in stock (see Figure 3.5), with additional drive systems in transit from overseas.

Figure 3.5

M113 warehouse with drive systems purchased in advance of need



Source: ANAO fieldwork at Bandiana facilities, September 2011.

3.62 This represents some \$51 million of stock. ANAO notes that the Prime Contractor has advised Defence that it has adopted a 'LEAN' manufacturing

methodology, part of which involves ordering components 'just in time' rather than holding unnecessary spares.¹⁴⁸ Warehouse holdings at September 2011 represented approximately 11 months worth of stock, and were apparently unconnected with progress toward delivering vehicles, with DMO noting that:

Delays in vehicle production do not impact upon deliveries of the sub-assemblies.

3.63 Defence further informed ANAO in March 2012 that the Major Upgrade Contract allows for early payment for early deliveries, and payment for such deliveries is required within 30 days of delivery.

Production schedule progress

3.64 From very early in the major upgrade project, delays have been evident. The 2008–09 audit report identified that the potential for delays in the delivery of upgraded vehicles had become apparent within eighteen months of the commencement of the Major Upgrade Contract in 2002. A range of technical problems delayed the development of the Initial Production Vehicles (IPVs) and, by late in 2006, had prompted Defence to cease payments to the Prime Contractor and commence global settlement negotiations.

3.65 An outcome of the global settlement negotiations with the Prime Contractor in late 2007 was the development of a new production schedule that retained December 2010 as the date by which all of the original 350 vehicles were to be delivered.¹⁴⁹ At the conclusion of the previous audit in March 2009, 42 vehicles had been accepted by DMO, 37 of which had been provided to Army units.

¹⁴⁸ 'LEAN' manufacturing is a management philosophy based on the Toyota Production System. Resources are focused on creating value for the end customer. Resources which do not create value are minimised or eliminated.

The Prime Contractor advised the ANAO in April 2012 that:

The Lean activities undertaken by [the Prime Contractor] and advised to the Commonwealth relate to improved production processes to improve Takt times to increase production rates and did not include warehousing and component ordering activities. We kept the purchase of parts and components in line with contract dates, however when the production schedule slipped this caused an increased warehouse stock to accumulate.

Takt time is a measure often used in Lean and represents the maximum time allowed to produce a product in order to meet demand; production is expected to have a pace that is equal to (or less than) the takt time (see 'What is takt time', <<http://www.valuestreamguru.com/?p=91>>, accessed 17 April 2012).

¹⁴⁹ The original contract schedule set 2006 as the date for the introduction into service of the initial tranche of upgraded vehicles.

Efforts to recover schedule

3.66 Prior to the 2007 global settlement all production under the M113 Major Upgrade Contract was undertaken at Defence's purpose-built facilities at Bandiana, Victoria. As part of the October 2008 announcement of the decision to upgrade an additional 81 APCs under the M113 Major Upgrade Contract, the Minister for Defence announced that the Prime Contractor was opening additional facilities in Williamstown, Victoria and Wingfield, South Australia to ensure all of its delivery commitments were met.¹⁵⁰ At the time of audit fieldwork, the facilities were undertaking the following work:

- The Bandiana facility remained the primary source of vehicle extension and assembly.
- The Wingfield facility had built all of the IPVs; some ACVs, AFs, and APCs (approximately 99 vehicles in total as at March 2012); and armour kits.
- The Williamstown facility had undertaken hull extensions (approximately 35 as at March 2012) and produced approximately 280 fuel tanks.

3.67 The additional cost of establishing and operating the facilities at Wingfield and Williamstown, including transportation costs, has been borne by the Prime Contractor. Defence informed the Minister for Defence that the cost to the Prime Contractor of establishing the facilities was approximately \$6 million.

3.68 The 2008–09 ANAO audit identified that the schedule agreed as a result of the 2007 global settlement produced significant schedule compression. Figure 3.6 compares the schedules previously reported with progress to date, showing that:

- the 'ramp up' of production announced by the then Parliamentary Secretary for Defence Procurement in May 2008, in order to produce 10 vehicles per month and meet the global settlement December 2010

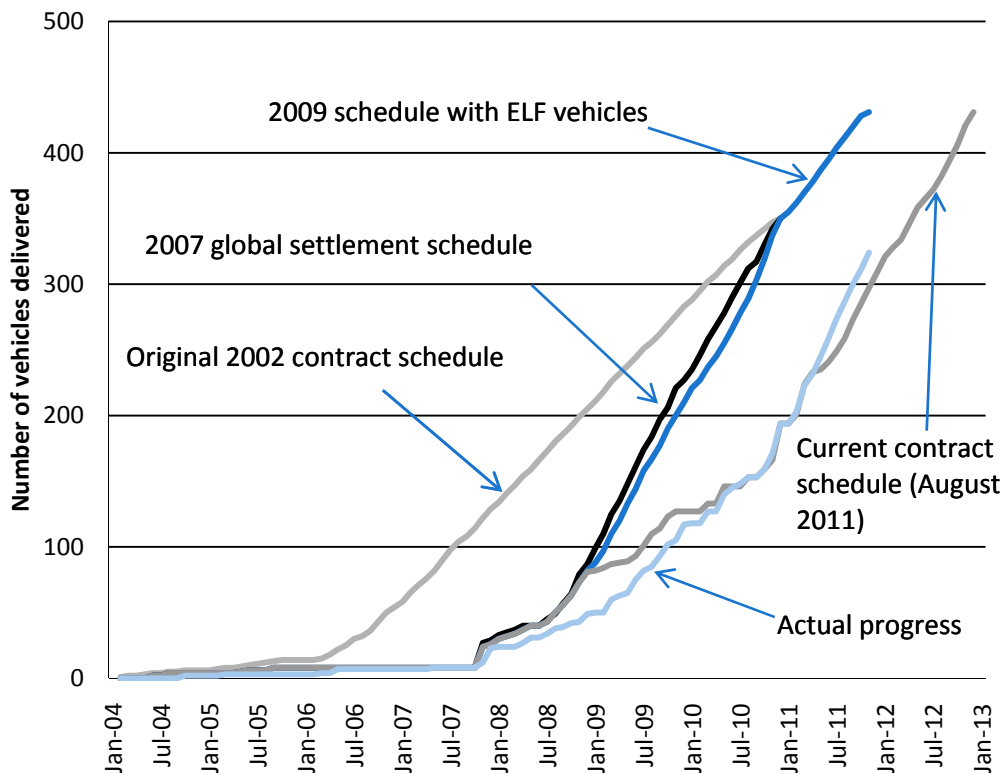
¹⁵⁰ Minister for Defence, *Government Approves Additional Armoured Personnel Carriers*, Media Release MIN 148/08, 29 October 2008. An October 2008 Ministerial briefing informed the Minister for Defence that '[the Prime Contractor] have committed to open an additional production line, at their expense, to achieve the required schedule'. Defence was unable to provide clear evidence of the Prime Contractor making this commitment.

deadline for delivery of all 350 originally contracted vehicles, did not occur;

- improvements in production rates generated by the additional facilities only became evident after November 2010; and
- the improved production rate of 12 vehicles per month was not sufficient to allow recovery of the accumulated schedule delay and enable the intended delivery of all 431 vehicles by July 2011 (with the first 350 vehicles due by December 2010 and the 81 ELF vehicles due by July 2011).

Figure 3.6

Contracted and actual vehicle delivery, 2004 to December 2011



Source: ANAO analysis of Defence documentation.

3.69 Table 3.3 highlights schedule slippage since the previous ANAO audit. It shows that, by December 2010, there had been no recovery of schedule as planned under the 2007 global settlement schedule. Of the 194 vehicles accepted for service by December 2010, 140 were APCs; 29 were Armoured Fitters (AFs); 13 were ARVLs; nine were ACVs; and there were two ALV IPVs

and one AA IPV. Under the global settlement schedule, more APCs and AFs should have been delivered, while substantial progress should have also been made with delivery of ACVs and ALVs.

Table 3.3

Vehicles accepted over time compared to 2007 global settlement schedule

Date	Vehicles accepted by DMO	Vehicles due under global settlement schedule	Schedule slippage
March 2009	50	125	75 vehicles
June 2010	145	290	145 vehicles
October 2010	159	330	171 vehicles
December 2010	194	350	156 vehicles

Source: ANAO analysis of Defence data.

3.70 Since the 2007 global settlement, there have been five major contract amendments that have re-baselined the production schedule. The amendments re-ordered the production schedule (delaying production of the ambulance, logistics, command and mortar variants), and extended the due date for final vehicle delivery (from December 2010 until December 2012).¹⁵¹

Issues impacting schedule

3.71 Since the 2007 global settlement was reached, a range of factors have impacted on project schedule performance, including:

- delays in extending vehicles under the CSP Contract;

¹⁵¹ Since 2007 there have been four different contractual end dates DMO has reported against:

- the 2007 global settlement required final vehicle delivery by December 2010 (previously November 2010);
- the inclusion of additional ELF vehicles in the contract extended the final vehicle delivery to November 2011;
- the mortar vehicle scope change extended the final vehicle delivery to April 2012; and
- the second settlement negotiations, concluded in August 2011, extended the final vehicle delivery to December 2012.

- larger than anticipated numbers of vehicles requiring rework following quality assurance inspections, placing pressure on facilities at Bandiana where there is limited room for rework;¹⁵²
- alleged deficiencies at the Defence-owned facility at Bandiana causing delay, most notably in 2009;¹⁵³
- hull delamination, necessitating the development of an acceptable repair technique by DSTO (see also Table 4.1), requiring additional preparation work on the hulls;¹⁵⁴
- inadequate ground clearance delaying production of the logistics variant, which under the 2007 global settlement was scheduled to be delivered from January 2010; and
- longer than anticipated design development of an extended mortar vehicle in the absence of an appropriate repair and extension technique to ensure that the rotating mortar base plate is not damaged.

3.72 In addition, a shortage of communication harnesses is inhibiting the issue of upgraded vehicles by Defence (discussed in chapter 5). However, these are government furnished equipment to be provided to the Prime Contractor by Defence. Defence informed the ANAO that the harnesses, which are no longer manufactured, are also used on other ADF vehicles currently in service and deployed on operations. The M113 upgrade Project Director indicated in June 2010 that further production vehicles would not be issued to 1 Brigade until communication harnesses could be sourced and installed. During 2011,

¹⁵² The previous audit found significant production delays caused, in part, by re-work on extended hulls to correct faults before they could enter or continue along the assembly line. Some faults are also caused by variations in the size and build of M113 hulls, which means assembly more closely resembles a jobbing shop rather than a production line, with a corresponding lower rate of production. Defence advised ANAO during the previous audit that:

The rework rates are primarily managed by the [Prime] Contractor—Defence does not pay for rework and therefore does not conduct formal analysis of rework rates ... any subsequent impact on the schedule is the responsibility of the Prime Contractor to correct.

¹⁵³ ANAO Audit Report No. 27 2008–09, *Management of the M113 Armoured Personnel Upgrade Project*, p. 104.

¹⁵⁴ DMO considers that no delay was caused by this issue, as throughout the relevant period sufficient hulls were approved for extension to keep production going. The Prime Contractor informed ANAO in March 2012 that the work required to strip hulls and then determine the delamination created a shortage of hulls for the production line in Bandiana.

The repair technique was not subject to mine-blast testing, as the project director indicated that the source of the de-lamination is not in areas normally exposed to blast.

vehicles were gradually delivered to Army as communication harnesses became available.

3.73 The November 2010 Budget Estimates project review on Land 106 stated that:

[*The Prime Contractor*] is approximately 68 vehicles behind schedule and has been reporting that it will be approximately 75 vehicles short by Dec 2010, due to the interruption caused by introducing 'LEAN' practices into the production line. Once the introduction of 'LEAN' practices is finalised [*the Prime Contractor*] expects to recover this lost ground and make further gains in the overall schedule, but not complete schedule recovery ...

[*The Prime Contractor*] remains on schedule for Engineering and Logistic milestones, but is under commercial pressure to reduce costs. [*The Contractor*] is currently funding its responsibilities for schedule delays, but is now attempting to claw back schedule recovery costs by claiming [*Defence*] is responsible for the delay. All major [*Prime Contractor*] decisions are being channelled through their contracting cell for commercial clearance prior to acceptance. After the introduction of 'LEAN' practices into the production lines it is likely there will be no further investment by [*the Prime Contractor*] in schedule recovery.

3.74 As discussed in Chapter 4, at this time Defence and the Prime Contractor were in the process of making claims and counter-claims in relation to project performance, which culminated in a contract renegotiation and contract amendment in August 2011.

4. Contract renegotiation and project reporting

This chapter outlines the steps taken to recover the production schedule following contract negotiations in 2007. Continued difficulties led to another round of contract negotiations in 2010 and 2011. The chapter concludes with an overview of reporting to government on the progress of the project.

Introduction

4.1 At the time of the previous ANAO audit in March 2009, Defence and the Prime Contractor had agreed on steps to be taken by the Prime Contractor to recover the production schedule for the delivery of 350 upgraded M113s by December 2010. This included the Prime Contractor establishing additional facilities at Williamstown in Melbourne and at Wingfield near Adelaide to extend M113 hulls, at no additional cost to the Commonwealth. This came after another schedule recovery proposal—to run an additional shift at the Bandiana facilities—failed to eventuate due to personnel shortages.

4.2 At the time, the ANAO noted that the recovery schedule was challenging and would require close management.¹⁵⁵ Similar concerns were expressed by the Joint Committee of Public Accounts and Audit in September 2009.¹⁵⁶

4.3 As an incentive, the terms of the 2007 global settlement¹⁵⁷ included a \$2.7 million bonus payment should the Prime Contractor succeed in delivering all of the originally contracted 350 vehicles by December 2010. This amount was approximately equal to the effective value of liquidated damages the Prime Contractor paid under the global settlement.

¹⁵⁵ ANAO Audit Report No. 27 2008–09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, p. 15.

¹⁵⁶ Joint Committee of Public Accounts and Audit, *Report 417: Review of the Auditor-General's Reports tabled between February 2009 and September 2009*, June 2010, p. 30.

¹⁵⁷ The 2007 global settlement is discussed in detail in the previous ANAO audit of the M113 project; ANAO Audit Report No.27 2008–09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, pp. 76–92.

Continued delays lead to further contract negotiations

4.4 Delays in vehicle production led to another contract renegotiation, which formally began in February 2011 and concluded in August 2011. Preliminary discussions commenced in June 2010, when DMO and the Prime Contractor met to consider the extent, cause and impact of production delays. Up until the end of 2010, DMO was of the view that the delays were the responsibility of the Prime Contractor, and that the Commonwealth would be entitled to recover liquidated damages.

4.5 During the latter half of 2010, the Prime Contractor sought to move the date for which it would be eligible for the \$2.7 million bonus payment for delivering all vehicles from December 2010 to August 2012. The Prime Contractor argued this was reasonable, on the basis that the company had invested a considerable amount in additional facilities designed to recover the schedule.¹⁵⁸

4.6 In July 2010, the Director Armoured Fighting Vehicle Systems Program Office briefed Head Land Systems (HLS) that:

The Project Office does not support incorporation of an incentive bonus into the revised schedule linked to the new target date of [31 August 2012].

- It is difficult to justify a bonus for the late delivery of vehicles, particularly given the previous poor performance of [*the Prime Contractor*].
- [*The Prime Contractor*] continues to seek opportunity for excusable delay to offset their current position.
- There is no value for money content for the Commonwealth of Australia.

As an alternative, you may wish to consider a reduced incentive linked to the current final delivery date of [31 August 2012] or an earlier date.

4.7 Head Land Systems was also advised by the M113 project office in July 2010 that it 'continues to recover Liquidated Damages for the late deliveries against the current contracted schedule',¹⁵⁹ with approximately \$0.65 million

¹⁵⁸ In April 2012, the Prime Contractor informed ANAO that it also sought to move the incentive payment to take into consideration delays it alleged were caused by hull delamination, lifting eye cracking and facility failure at Bandiana (see paragraph 4.8).

¹⁵⁹ The agreed schedule at that point for all 431 upgraded vehicles was for the delivery of the final vehicle by April 2012.

the value of four months delay (if production was delayed from April to August 2012).¹⁶⁰

4.8 In September 2010, the Prime Contractor counter-claimed \$5 million in excusable delay claims, arguing that the Commonwealth had been responsible for the production delays. Four key issues accounted for a total of 28 weeks (or \$4.95 million) of the Prime Contractor's claims of delay against DMO:

- laminar cracking (hull delamination)¹⁶¹—Prime Contractor claimed 12 weeks delay (\$3.6 million) on the basis that this issue delayed the induction of hulls into the CSP process;
- lifting eyes¹⁶²—Prime Contractor claimed 4 weeks delay (\$400 000) on the basis that problems with the lifting eyes on hulls (which are Government Furnished Equipment) caused delays moving hulls through the CSP process;
- development of the AM variant—Prime Contractor claimed 9 weeks delay (\$200 000) on the basis that Defence had delayed the progress of this process; and
- facility failure—Prime Contractor claimed 3 weeks delay (\$750 000) on the basis of delays to production caused by failures of the Defence owned facilities.¹⁶³

4.9 Based on internal advice, DMO rejected the Prime Contractor's counter-claims and proposed a revised schedule in November 2010, triggering the dispute resolution procedures in the Major Upgrade Contract. DMO sought to

¹⁶⁰ Defence informed ANAO in March 2012 that:

It should be noted that Liquidated Damages are not crystallised under the [*Major Upgrade Contract*] until the Commonwealth chooses to do so. Liquidated Damages have been imposed by the Project throughout its life for late delivery.

With specific reference to the figure of \$0.65 million advised to Head Land Systems, this was the projected amount of liquidated damages that would accumulate ... liquidated damages were not crystallised and therefore the \$0.65m represents a potential value only.

¹⁶¹ Aluminium and other metals can develop 'onion skin' fractures, where the metal fractures in layers through its depth. This type of fracturing is commonly called a lamination fracture, in which layers of sound metal are separated by corrosion products and voids.

¹⁶² Lifting eyes are steel loops attached to the front and rear of an M113 that allow it to be lifted a by crane on to transport platforms. Lifting eyes are also used by the Prime Contractor to move hulls through the hull preparation and extension process conducted under the CSP Contract.

¹⁶³ Facility failures included insufficient compressed air supply and power for welding bays; water contamination; and breakdowns in equipment, including the Computer Numeric Cutting (CNC) machine.

begin a process to accept a revised delivery schedule that provided for the delivery of the final vehicles in late 2012. Defence advised the Minister for Defence Materiel and Minister for Defence in February 2011 of the further project schedule delays, stating that DMO was continuing to collect liquidated damages, and that:

the Commonwealth has rejected [*the Prime Contractor's*] claims [*that the Commonwealth is responsible for schedule delays*] and is seeking a global settlement of all matters including the delivery schedule.¹⁶⁴

4.10 Preliminary discussions were then held with the Prime Contractor in February 2011 to clarify the issues in dispute and each party's position. The main issues discussed are listed in paragraph 4.8, with other issues raised by the Prime Contractor including:

- maintenance of Government Furnished Facilities –namely the Bandiana site;
- Government Furnished Equipment (GFE), both in general and with specific reference to hulls and periscopes;¹⁶⁵
- maintenance of CSP jigs, fixtures and tooling;
- definition of System Acceptance;¹⁶⁶
- Integrated Logistics Support manuals; and
- GFE parts supply.¹⁶⁷

¹⁶⁴ Despite informing the Ministers that Defence was seeking a global settlement, DMO informed ANAO in December 2011 that they were not seeking a global settlement, rather a 'major contract renegotiation'. Subsequently, in March 2012 DMO further informed ANAO that there was not a major contract renegotiation, rather a 'contract renegotiation'.

¹⁶⁵ Periscopes on the M113s are bullet-proof glass panels above the driver and crew commander hatches that provide protected sight when the hatches are closed.

¹⁶⁶ The liquidated damages provisions of the M113 Major Upgrade Contract provide that no damages are owed until the Commonwealth elects to apply them. The contract further provides that the Commonwealth may make this election at any time prior to 'System Acceptance', as the final milestone under the contract. However, the 2008–09 ANAO audit noted that this milestone was not defined in the relevant part of the contract. Defence advised the ANAO during that audit that 'the 'System Acceptance' milestone is not in use in the contract'. The Defence contracting template in use at the time the Major Upgrade Contract was developed (SMART 2000) noted that 'the System Acceptance milestone is a mechanism to notify the Contractor that it has fulfilled all of its obligations'. SMART 2000 also noted that [System Acceptance] usually triggers a final payment of between 5 per cent and 15 per cent of the contract amount that may be withheld if any obligations are outstanding.

¹⁶⁷ Government Furnished Equipment involves both new items and refurbishment of existing items. The vehicle communication harnesses are an example of GFE that has experienced shortages. GFE also includes extended hulls ready for assembly, even though they are extended by the same contractor.

4.11 After this February meeting, DMO determined that further investigation of the issues was required to establish the merits of the arguments. This investigation involved Land Manoeuvre Systems Branch taking a broader perspective of the dispute (beyond the dispute resolution clauses in the contract), engaging organisational support from contracting and legal areas, and having other DMO project areas review the proposed delivery schedule.

4.12 Closer examination of the issues resulted in DMO amending its negotiation position on the basis that:

- substantiating DMO's positions with documentation on specific claims would be difficult and take an extended period of time;
- in some cases the Prime Contractor had more documentation and more developed counter-claim arguments;
- DMO may have already undertaken actions, or provided advice, that would contradict its own negotiation position; and
- the parties had been acting outside of the contract for a significant period of time, primarily in relation to what Defence were to provide for the upgrade (listed in the contracted government furnished material list, which was inaccurate) and the delivery schedule (with supplies being accepted out-of-sync with the schedule), which would undermine DMO's attempts to enforce contractual dispute resolution clauses.¹⁶⁸

4.13 A key issue between Defence and the Prime Contractor related to government furnished equipment. To complete an upgraded M113 assembly, certain components of the vehicle are provided by Defence. These components are known as government furnished equipment. There has been, and continues to be, a shortage of certain items of government furnished equipment, such as communications equipment (see paragraphs 5.27 to 5.29). There has also been

¹⁶⁸ Defence Materiel Organisation, *Project Land 106 Negotiation Directive – Dispute Resolution Negotiations – April 2011*.

In response to the proposed audit report, Defence informed the ANAO that 'while Defence considered it would be possible to refute many of the Prime Contractor's claims, if given unlimited time, closer examination of the contract and previous actions of both parties led Defence to conclude a commercial approach would provide a better result than a contractual approach, with agreement being reached that the issues were complex and multi-faceted and that responsibility for delay is shared between the Commonwealth and the Prime Contractor'.

confusion between Defence and the Prime Contractor as to those items which are government furnished equipment, and those items to be provided by the Prime Contractor in order to assemble the vehicles. To overcome equipment shortages and confusion over responsibilities for particular items, DMO had been accepting vehicles with items missing, and sourcing these items after vehicle acceptance. DMO had considered that '[government furnished equipment] management is a constant irritation for both parties'.

4.14 DMO's negotiation focus was to develop a new, realistic production schedule,¹⁶⁹ and to provide contractual certainty over government furnished material and the contractual liquidated damages regime. This was to be done in a timely fashion, not affect ongoing production, and to ensure that the additional production facilities remained open. As mentioned in paragraph 3.2, the Prime Contractor opened additional facilities, at its own cost, to meet the revised schedule agreed in the contract change that included the additional 81 APCs under the ELF initiative. However, there was no contractual basis on which Defence could require the Prime Contractor to keep the additional facilities open until contract completion.¹⁷⁰

4.15 Defence also informed the ANAO in March 2012 that in undertaking these negotiations:

Defence's requirement was to get the vehicles as quickly as possible, while keeping the [Prime] Contractor motivated to perform. Accordingly, a commercial 'win/win' solution was required, irrespective of the contractual issues—which were subject to interpretation by both parties.

4.16 In order to achieve these goals, DMO was willing to: provide an incentive payment for the Prime Contractor to meet the revised delivery date, and seek that each party withdraw its claims regarding the period of delay (see paragraph 4.8). Factoring in the extent of production schedule delays, and the financial difficulties of the Prime Contractor, DMO's approved negotiation directive considered that the most likely final outcome of the negotiations would involve granting the Prime Contractor its delay claim of six months. The negotiation directive listed the worse case outcome of the negotiations as

¹⁶⁹ The authorised April 2011 contract negotiation directive noted that:

It is clear that the compressed schedule resulting from global settlement in 2007 was overly aggressive. This was clearly identified as early as 27 March 2009 by the ANAO in Audit Report No. 27 *Management of the M113 Armoured Personnel Carrier Upgrade Project*.

¹⁷⁰ Defence informed the ANAO that the Williamstown M113 facility was closed in December 2011.

the Prime Contractor choosing the commercially viable option of closing down the additional facilities and paying liquidated damages against a subsequent slower production rate, with the likely outcome of this scenario being schedule slippage of 12 months (from April 2012 to April 2013) and associated liquidated damages payable by the Prime Contractor of approximately \$2.6 million. The negotiation directive noted that:

This delay in the delivery of the capability is unacceptable to Army.

4.17 Negotiations were due to recommence in April 2011 and conclude by May 2011.

Schedule review

4.18 In July 2011, two DMO schedulers reviewed the revised schedule proposed by the Prime Contractor in the negotiations. The review provided a critical appraisal of the Prime Contractor's proposed schedule. It found that:

the proposed schedule is achievable yet there is a low level of confidence that [*the Prime Contractor*] will achieve their Oct 12 target. The Dec 12 target is considered more likely however to have inherent risks.

4.19 The review also noted that the revised schedule provided for review by the Prime Contractor:

was of insufficient detail to make any form of [*value*] assessment and was found to have a large number of inconsistencies. It seems that [*the Prime Contractor*] undertakes considerable effort to provide a summary schedule to the Commonwealth rather than to disclose the detailed schedule that it uses to manage the project. Whilst undertaking the review [*the Prime Contractor*] allowed us the opportunity to see and make enquiries about the detailed schedule yet this access was limited. As such, in-depth analysis and interrogation of the detailed schedule could not be undertaken. A general lack of willingness to provide detailed data generates suspicion and concern.

4.20 Notwithstanding the risk associated with the schedule, the review recommended that the Commonwealth accept the revised schedule.

4.21 The risks identified by the schedule review were:

- the ability of the Bandiana facility to maintain full capacity up until final delivery;
- the Prime Contractor's model of assembly time for each variant was mostly well short of recent experience;

- Williamstown might not have finished all its planned work when closed in December 2011 (as proposed by the Prime Contractor), requiring extra effort elsewhere (likely Bandiana);
- the Prime Contractor had a commercial interest to cease production at Wingfield as soon as possible, even if production ran behind schedule; and
- a number of general project risks could impact on schedule, such as:
 - the extra work required for the AM hulls;
 - availability of government furnished equipment;
 - effective management of the CSP; and
 - reduced quality in order to meet schedule constraints.

4.22 The review by DMO schedulers also noted three opportunities to accelerate production should the schedule slip:

- the potential of overtime and double-shifting at Bandiana (although recruiting and retaining skilled personnel was a constraint);¹⁷¹
- assembly work could be conducted in the CSP bays [at the Bandiana Facility] as CSP work concluded (although this was subject to having sufficient workforce); and
- the Wingfield plant had capacity for additional assembly (although it was noted that the Prime Contractor might not consider it commercially viable).

4.23 Defence informed ANAO in March 2012 that, whilst the review did identify high risks to the schedule, continued progress has meant that the risk profile has subsequently significantly improved.

Negotiation outcomes

4.24 Defence and the Prime Contractor reached in-principle agreement in May 2011, with agreed outcomes only finalised late in August 2011. The negotiation deed of agreement listed the key outcomes of the negotiations:

¹⁷¹ At the time of the previous audit, the Prime Contractor had proposed to run a second shift on the vehicle assembly line at Bandiana. However, the Prime Contractor could not recruit sufficient personnel to staff this shift.

- A. The parties have agreed that the cause of all current delays under the M113 Upgrade Contract are complex and multi-faceted and that responsibility for the delay is shared between the Commonwealth and [*the Prime Contractor*].
- B. In consideration of this agreement, [*the Prime Contractor*] has withdrawn all claims, including the delay claims previously submitted under draft v.1 [*Contract Change Proposal*] 205 and the Commonwealth has not applied Liquidated Damages for revising the schedule for delivery of all vehicles against all variants by 9 December 2012. Liquidated Damages have been reset against this December 2012 schedule.
- C. The Commonwealth has incentivised [*the Prime Contractor*] to deliver all vehicles against all variants by 31 October 2012 through a series of four bonus payments to maintain the current production run rate (3 vehicles per week) and a final bonus payment targeted at delivery of all vehicles by this end date.
- D. [*the Prime Contractor*] ha[s] agreed to amended Liquidated Damages provisions to make them substantially more robust.
- E. The Commonwealth confirms that it is obliged to continue to act reasonably and lawfully and in accordance with the terms and conditions of [*the Major Upgrade Contract*] in fulfilling its rights and obligations as Contract Authority.
- F. The parties have agreed that an updated Government Furnished Materiel List is a necessary element to complete the Contract.

4.25 The agreed contract change proposal notes that, because responsibility for delay is shared, the contract schedule is to be re-baselined at no cost.

4.26 Under this contract change, four incentive payments to the Prime Contractor (one of the outcomes listed above) are staggered at three-monthly intervals to the end of June 2012, with a larger final payment for delivery of all 431 vehicles by the end of October 2012, as shown in Table 4.1. The total incentive offered is \$2.8 million (GST inclusive), which is comparable with the \$2.7 million offered under the 2007 global settlement had the Prime Contractor successfully delivered the first 350 vehicles by December 2010. Of this \$2.8 million, \$1.2 million is payable should the Prime Contractor deliver all vehicles 39 days earlier than the renegotiated contract end date (9 December 2012). The due date for the final incentive payment of 31 October 2012 is:

- two months later than the end date of August 2012 the Prime Contractor had been seeking in late 2010;

- six months later than the previous contracted due date of April 2012, negotiated in February 2010, which took into account the decision to extend the AM; and
- 15 months later than the date the Government was originally advised the project would be finished when approval was sought in 2008 for the additional 81 ELF vehicles (July 2011).

Table 4.1

Incentive arrangements for vehicle delivery

Milestone	Requirement to obtain incentive payment	Approximate delivery rate required from July 2011 onward	Value of payment
Quarter 1 incentive	Delivery of 295 vehicles by 30 September 2011	12 vehicles per month	\$400 000
Quarter 2 incentive	Delivery of 328 vehicles by 31 December 2011	11 vehicles per month	\$400 000
Quarter 3 incentive	Delivery of 361 vehicles by 31 March 2012	11 vehicles per month	\$400 000
Quarter 4 incentive	Delivery of 382 vehicles by 30 June 2012	10 vehicles per month	\$400 000
Final acceptance incentive	Delivery of 431 vehicles by 31 October 2012	9.5 vehicles per month	\$1.2 million
Total		11 vehicles per month	\$2.8 million

Notes: Figures are GST inclusive. Vehicle delivery requirements include Initial Production Vehicles.

Source: ANAO analysis of Defence documentation.

4.27 In response to the proposed audit report, Defence explained the purpose and rationale for the incentive payments in the following terms:

The prime imperative was to improve the production rate, achieving the delivery of the vehicles rapidly and realistically, while keeping the contractor motivated to perform and its additional production facilities open. Accordingly, DMO developed an overarching commercial strategy to provide a sound baseline for both parties to move forward and deliver residual elements of the contract.

4.28 Defence consider that the incentive payments will help the Prime Contractor keep their additional facilities open longer, reducing remaining schedule risk. For example, production at the Bandiana facility has been behind schedule, so the production of eight APCs has been shifted from Bandiana to Wingfield to maintain schedule.

4.29 The terminology used in the incentive arrangements is 'delivery', which carries a different contractual meaning from 'acceptance' (which occurs when DMO counter-signs a supplies acceptance certificate). There can be time lags between the Prime Contractor's delivery of an upgraded vehicle to DMO and acceptance of the vehicle if defects lead DMO to reject a delivered vehicle as a non-conforming supply. However, DMO informed the ANAO that both the Prime Contractor and DMO have been working on the understanding that the incentive arrangements relate to accepted vehicles. DMO further advised ANAO that the Prime Contractor met the first and second quarter targets and received the applicable incentive payments, and has delivered sufficient vehicles to meet its third quarter target. Defence considers that improvements to the liquidated damages clause of the contract were negotiated and agreed through this settlement process, and that the contract has been amended to allow:

- recovery of damages at a rate of 0.1 per cent of the milestone value on a daily basis (previously weekly);
- a grace period of 30 days (previously 90),¹⁷² which provides the Prime Contractor with an extra 30 days to deliver without incurring a penalty; and
- damages to be calculated from the first day of delay (previously starting after the grace period).¹⁷³

4.30 Liquidated damages continue to apply to all remaining deliverables under the contract. The intention of the new damages provisions is to avoid a situation where the Prime Contractor makes a financial decision to close down the additional production facilities it opened at its own cost and elect instead to pay damages on delayed milestones.

4.31 The contract amendment also updated the GFE list and now also provides specified delivery dates for GFE where previously the contract simply provided for GFE to be provided when requested.

¹⁷² A grace period provides the Prime Contractor with additional time to deliver a contractual milestone after its due date without having to pay liquidated damages.

¹⁷³ On 24 August 2011, the Contractor provided DMO with agreed liquidated damages amounts for the period up until 22 August 2011. These totalled \$100 000, with approximately two thirds allocated as work in kind.

4.32 The requirement for and the outcomes of this renegotiation, where each party withdrew its claims regarding the period of delay, can be traced to limitations of the 2007 global settlement:

- By not adequately scrutinising the feasibility of the 2007 global settlement delivery schedule, DMO agreed to an unrealistic production schedule, with delays evident well before renegotiations began in 2010.
- Improvements to the liquidated damages regime were an item for negotiation in the 2007 global settlement. Defence had previously received advice that the Major Upgrade Contract's liquidated damages provisions were in need of substantial revision. However, changes to the relevant contractual provisions were not achieved as part of the 2007 global settlement. The 2008–09 ANAO audit recommended that Defence improve liquidated damages arrangements in future major acquisition contracts.¹⁷⁴

4.33 DMO's negotiation directive for the 2011 negotiations stated that liquidated damages are not owing (crystallised) unless they are a debt payable under the terms of the contract. This contrasts to advice provided to the November 2010 Budget Estimates review and to the Minister, that liquidated damages were being recovered (see paragraphs 4.7 to 4.9). The ANAO notes that the liquidated damages provisions in the contract provided that no liquidated damages were owed until the Commonwealth elected to recover them. Because DMO did not explicitly notify the Prime Contractor of its intent to recover damages against specific milestones, damages were not applied to late deliveries and hence were not considered a debt (see also footnote 160 for additional explanation).

4.34 In respect of the \$5 million in postponement costs the Prime Contractor counter-claimed as part of the settlement negotiations, Head Land Systems Division advised the General Manager Systems as part of the Gate Review process that:

Detailed investigation of those claims revealed potential merit in whole or part. Certainly the Commonwealth did not have sufficient evidence at hand to defend [*the Prime Contractor's*] claims on the merits, at least not without protracted and counter-productive investigation and negotiations.

¹⁷⁴ Audit Report No.27 2008–09, *Management of the M113 Armoured Personnel Upgrade Project*, p. 89, Recommendation No.3.

4.35 As part of the sign-off process for the August 2011 Gate Review (see paragraph 4.38), General Manager Systems sought advice from Head Land Systems Division on:

- whether DMO was to receive any compensation for schedule delay as an outcome of the settlement;
- whether liquidated damages had been triggered and a debt to the Commonwealth waived; and
- whether the settlement was cleared by DMO Legal and was consistent with legal principles and practice.

4.36 Head Land Systems advised that the negotiation strategy in the contract negotiation directive, the contract negotiation report, and the agreed contract change were all cleared through DMO Legal. The legal approach adopted by Defence was that the negotiations were not a 'crystallised formal claim or litigation matter resulting in a formal settlement, but rather remained a commercial argument on the exact composition of draft [*Contract Change Proposal 205*]'.

Head Land Systems further advised:

Note that the view taken in this matter by all parties including two Chief Contracting Officers and members of DMO Legal was that [*the Prime Contractor*] and the Commonwealth were agreeing on the composition of CCP 205; not dealing with a 'monetary claim' under Part 1, 4.4 and Appendix C of the *Legal Service Directions*—which details specific methodology and appointments for handling formal claims against the Commonwealth. The matter could therefore be commercially settled within the parameters of the contract as long as legislation and policy (such as waiving debts due to the Commonwealth) were not breached.

4.37 Defence did not consider its agreement to the final version of the relevant Contract Change Proposal (CCP 205) amending the Major Upgrade Contract, whereby Defence agreed not to seek approximately \$1 million through liquidated damages, was a debt waived.¹⁷⁵ Head Land Systems advised DMO General Manager Systems:

the Commonwealth did not make an election with respect to Liquidated Damages relating to the delay identified under CCP 205—the LDs did not crystallise as they were in dispute (subject to a postponement delay claim [*from*

¹⁷⁵ Defence advised ANAO in March 2012 that 'The Commonwealth did not make an election [*to impose liquidated damages*] and therefore no debt was due'.

the Prime Contractor]). We did not apply liquidated damages for re-baselining the contract. In the circumstances, this was not seen as a 'waiver' or failing to recover a debt due to the Commonwealth. The agreement between the parties acknowledged that the issues behind the delay subject to CCP 205 had been complex and that responsibility for the delay was to be shared.

August 2011 DMO project Gate Review

4.38 DMO conducted a Gate Review¹⁷⁶ in August 2011 to consider the outcomes of the negotiations and whether the status of the project warranted its return to the Projects of Concern list (see footnote 189).

4.39 The Gate Review noted that the new schedule agreed as a result of the 2011 negotiations carried a low-medium risk, and that 'the way ahead to complete the project is clear'. The preliminary analysis, which formed part of the Gate Review consideration, noted the production schedule review undertaken by DMO schedulers, yet did not raise any of its findings. As noted in paragraphs 4.18 to 4.22, the schedule review could not provide detailed analysis of schedule, and the summary schedule that was reviewed contained inconsistencies.

4.40 The incentive payments included in CCP 205 were designed, from Defence's perspective, to encourage the Prime Contractor to finish as early as possible and keep the additional production facilities open 'noting that a major risk to the health of the project was the threat of [*the Prime Contractor*] closing their production facilities (as it would have been cheaper to pay [*liquidated damages*])'.¹⁷⁷ The Williamstown production facility was closed in December 2011, and the Wingfield production facility is scheduled to cease production in October 2012.

¹⁷⁶ Gate Reviews are a DMO assurance process intended to improve project outcomes and ensure DMO is able to provide high-quality and reliable advice to Defence and the Government regarding the health and outlook of major capital projects. They are run by a board (referred to as a Gate Review Assurance Board—GRAB) consisting of a chair (generally a senior DMO manager), an independent member, and other DMO representatives. Prior to a Gate Review, preliminary analysis is undertaken on the project to inform the board's deliberations. The outcome of a Gate Review includes recommendations from the chair and action items for Defence and DMO.

¹⁷⁷ In announcing the Government's approval in October 2008 to purchase 81 additional APCs, the Minister for Defence stated that:

BAE Systems Australia is also opening additional facilities in Williamstown, Victoria and Wingfield, South Australia to ensure all of its delivery commitments are met.

Minister for Defence, *Government Approves Additional Armoured Personnel Carriers*, Media Release MIN148/08, 29 October 2008.

4.41 User acceptance and the reliability of the upgraded vehicles were reported as good in the August 2011 Gate Review report. However, Defence data indicates that, as at March 2012, 24 per cent of the fleet was grounded, and 37 per cent on restricted duties. This level of fleet availability has been a constant trend since 2010 (see Figure 5.1). Additionally, the entire M113 fleet was grounded twice in 2011 due to leaking brake reservoirs, and defective track assemblies (see Chapter 5).¹⁷⁸

4.42 The August 2011 Gate Review report stated at the time that assembled vehicles had been accepted from the Prime Contractor but had not been issued to Army because they lacked necessary GFE.¹⁷⁹ DMO advised the ANAO in December 2011 that the number of vehicles requiring retrofitting of GFE had been reduced to 40.

4.43 The Gate Review was signed off by the General Manager Systems on 30 August 2011, and the contract change proposal (CCP 205) was signed on the same day.

Conclusion on contract re-negotiation

4.44 The issues raised during the 2011 negotiations illustrate that the 2007 global settlement failed in its goal to create a clear and straightforward path to project completion by 2010. Improvements to the liquidated damages regime negotiated as part of the August 2011 settlement will provide less value to the project than if these changes had been made as part of the previous global settlement, as originally intended. When noting this failure to reach agreement on liquidated damages in 2007, the DMO 2007 settlement negotiation report stated that:

The liquidated damages triggering criteria within the contract will therefore remain unclear. This will only become an issue if new schedule delays are encountered.

4.45 Defence did not receive any direct monetary benefit for liquidated damages as part of the 2011 contract renegotiation, notwithstanding Defence's

¹⁷⁸ In response to the proposed audit report, Defence informed the ANAO that the target for serviceability of the M113 fleet is that at least 75 per cent be classified as 'Fully Functional' or 'Restricted Use', which Defence claim has been attained.

¹⁷⁹ The Gate Review noted that many of the deficiencies were minor, however there were several significant missing components. The main one was communication harnesses (see also paragraph 3.72). Other GFE deficiencies observed by the ANAO during fieldwork in September 2011 included periscopes and gun shields.

previous advice to its ministers in February 2011 that DMO was continuing to collect liquidated damages (see paragraph 4.9). Liquidated damages were traded off as part of the negotiations, which also involved the Prime Contractor withdrawing its \$5 million delay claim.

4.46 The March 2009 ANAO audit concluded that, given the state of the Major Upgrade Contract at the time and the Prime Contractor's position, the 2007 global settlement negotiation outcome was reasonable in the circumstances.¹⁸⁰ The 2011 renegotiation resulted in financial and schedule concessions by Defence. However, as mentioned above, it also resulted in the Prime Contractor withdrawing \$5 million worth of postponement claims that were open to dispute.¹⁸¹ Defence's continuing desire to achieve delivery of the upgraded vehicles as soon as possible, together with the implications of DMO's prior actions and advice to the Prime Contractor, were key factors in this outcome. In particular, longstanding problems with the M113 Major Upgrade Contract meant that the parties had been acting outside the contract for a significant period of time.

4.47 The settlement negotiations in 2010–11 also highlight problems with the interactions between the two key, but separate contracts—the CSP Contract for sustainment of Army vehicles and the Major Upgrade Contract. As noted in paragraph 4.8, some of the negotiation issues were related to the CSP Contract with the same Prime Contractor. Under the terms of the Major Upgrade Contract, these could not be used as an excuse for delay, notwithstanding that delays in the CSP had knock-on effects for the major upgrade schedule.

Reporting on project progress

4.48 Baseline dates are the dates used for day-to-day contract management and reporting. When contracts are amended, for example because of a scope change, delivery dates may be changed, and this then 'rebaselines' the project.¹⁸² For immediate project-reporting purposes, baseline dates should be

¹⁸⁰ ANAO Audit Report No.27 2008–09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, p.19.

¹⁸¹ Defence advised ANAO in March 2012 that:

While the achievement of the whole amount would have been unlikely, it is certain that the Contractor would have been entitled to a proportion of their claims had the parties proceeded to negotiate in detail.

¹⁸² The baseline date is defined as 'the original planned start and finish dates for a project or an activity when the schedule was baselined'. The baseline schedule is defined as the:

Footnote continued on the next page...

the basis of reporting. However, reporting on the progress of the M113 upgrade project against currently approved 'baseline dates' has not been, of itself, sufficient to provide a measure of performance over time, as the performance baseline has been repeatedly reset after the approval of contract changes. While rebaselining contracts is a normal part of day-to-day contract management, there will be times when reference to the original cost, schedule and capability targets will help put a project's performance in context, particularly when reporting on progress to Ministers and senior management.

4.49 The practice of only reporting against rebaselined dates has meant that senior management and government have received advice on project performance at times that is inconsistent over time and at odds with original project intentions. For example, a November 2010 DMO review for Head Land Systems used baseline data from different versions of Material Acquisition Agreements over time.

4.50 Further, internal DMO reporting on project progress has not always presented an accurate picture of current and future performance of the M113 upgrade project. For example, in July 2010 Head Land Systems was briefed that a revised schedule proposed by the Prime Contractor delayed final delivery from April 2012 (the delivery date for the final vehicle under the February 2010 contract amendment that provided for the extension of the mortar vehicles) to August 2012. The Director Armoured Fighting Vehicle Systems Program Office assessment provided in this brief indicated that the Systems Program Office was confident the revised schedule was achievable.¹⁸³ In support of this assessment the report stated that 'the required assembly target of 12 vehicles per month has been maintained or improved over the past

Fixed project schedule used in measuring project progress and contract performance. Any change caused by change in scope of the project invalidates the original schedule and necessitates a new baseline schedule.

See Association for Project Management, 'project management glossary: baseline date(s)' <<http://www.apm.org.uk/content/baseline-dates>> [accessed 12 July 2011]; <<http://www.businessdictionary.com/definition/baseline-schedule>> [accessed 12 July 2011].

¹⁸³ The brief stated that:

Schedule modelling is based on a Monte Carlo assessment with a 90% confidence rating that predicts four months delay against known issues, but offers a worst case scenario of eight months delay should these issues not be addressed.

ANAO notes that a high-level schedule for variant completion provided in the June 2010 CSSR report listed the Monte Carlo 90 per cent confidence assessment for the completion of the ALVs as being in February 2013.

three months'. However, over the three months May to July 2010, only 24 vehicles in total had been presented by the Prime Contractor to DMO, and only 18 of these vehicles were accepted by DMO.

4.51 In July 2010, the Prime Contractor submitted a revised schedule proposing a final delivery date of August 2012. A November 2010 brief for Head Land Systems stated that:

The Project Office assessed the revised [*Prime Contractor's*] schedule as achievable, provided [*the Prime Contractor*] remains committed to improving its production processes. The forecast schedule slippage represents approximately three per cent variation in the production schedule against the 10 year acquisition cycle of the project. Engineering and Logistic support milestones remain on schedule.

4.52 On its face, this statement suggests that the delay over the ten year contract was approximately three and a half months. It does not account for the significant schedule delays the project has encountered over its ten-year operation, since the project became a major upgrade in 2002. Defence had advised the Government in 2002, when seeking approval for the major upgrade, that an in-service capability would be achieved by mid-late 2006. As at December 2010,¹⁸⁴ only 194 of the first 350 production vehicles had been delivered (approximately 55 per cent). Additionally, by compressing the delivery schedule toward the end of the contract rather than having a consistent rollout of vehicles over time, Army has been limited in the training it can undertake with the fleet during production. This has been compounded by delays in delivering the full range of M113 variants, so that Army has not been able to exercise with the proper combinations of M113 vehicles needed to form the full range of combined arms teams.

Acquisition Overview Reports

4.53 Acquisition Overview Reports are monthly reports on project status and performance prepared by DMO for the 30 highest valued projects.¹⁸⁵ These reports are provided to the Defence Committee, the Minister for Defence and the Department of the Prime Minister and Cabinet. They provide a snapshot of

¹⁸⁴ The date by which all 350 of the originally contracted vehicles were to be delivered under the terms of both the 2002 original contract and the 2007 global settlement.

¹⁸⁵ Acquisition Overview Reports are provided to the Defence Committee, the Minister for Defence and the Department of the Prime Minister and Cabinet.

project schedule, cost and capability performance and use a traffic-light reporting system to summarise projected performance.

4.54 Between March 2008 and May 2010, DMO Acquisition Overview Reports for Land 106 listed performance for the project across all areas as 'green'. This was the case despite the September 2009 Acquisition Overview Report highlighting advice from the Prime Contractor that the December 2010 date for the first 350 vehicles would not be met. The March 2010 Report advised that 'the ability of the Prime Contractor to achieve the delivery of all 431 vehicles by [April 2012] is being closely monitored'. The July 2010 Report stated that the Prime Contractor's schedule was forecasting final deliveries by August 2012, four months after Final Operational Capability (FOC) was due under the applicable approved schedule at that time.¹⁸⁶ Yet this Report listed the FOC milestone as 'green', and the schedule performance trend showed no sign of the previous month's amber rating.

4.55 The November 2010 Report was the next to report the FOC milestone as amber, reporting that '[the Prime Contractor] is currently producing 12 vehicles per month'. The November 2010 Report could readily give the impression that a production rate of 12 vehicles per month had already been achieved for a period of time. However, DMO's records show that, in 2010, a total of 72 vehicles were accepted by DMO (and average rate of six vehicles per month) with May and November 2010 the only months where 12 or more vehicles were accepted.¹⁸⁷

4.56 ANAO Report No.20 2011–12 *Major Projects Report* also identified similar issues in relation to the 27 projects covered by that report:

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.¹⁸⁸

¹⁸⁶ Final Operational Capability is the point when all parts of a capability system can be operationally employed. It is the final milestone in capability delivery. Final Materiel Release is a milestone that marks the completion of DMO acquisition responsibilities, and precedes Final Operational Capability. The Final Materiel Release milestone was introduced in Defence in 2010, and was incorporated into the December 2011 version of the M113 upgrade project's Materiel Acquisition Agreement. The M113 Final Materiel Release milestone is the delivery of all production vehicles and associated support, and is due by December 2012.

¹⁸⁷ As noted in paragraph 4.29, there may be some variation between 'production' and 'acceptance' numbers, however ANAO focuses on vehicle acceptance numbers, as it is only at this point that the vehicle is handed over to Defence as suitable for use.

¹⁸⁸ ANAO Report No.20 2011–12, *Major Project Report*, p. 26.

4.57 The Acquisition Overview Reports on Land 106, provided to Defence and DMO senior management and to Ministers, have not always provided clear and accurate advice on the extent of delays in the project, and there would be merit in Defence reviewing the preparation of these reports to ensure their accuracy in the future.

Reporting to government

4.58 Following the 2007 global settlement, Defence characterised the overall production schedule as high-risk, while maintaining that the Prime Contractor would deliver 350 vehicles by the due date of December 2010 (later reduced to 329 following the August 2009 decision to extend the AM variant). The tension inherent in this position is reflected in Defence's reporting to government on progress over time, which has not always been accurate in conveying the extent of the risk to schedule and delay in vehicle delivery occurring. Inaccurate advice provided to government by Defence on the progress of the project between May 2008 and September 2011 is summarised in Table 4.2.

4.59 In addition, on several other occasions between 2008 and 2011 Defence provided advice to Ministers that was inconsistent with, and/or did not reflect, actual project progress and conditions 'on the ground'. This advice was provided in the context of the ELF and AM scope changes, as well as in relation to updates on project progress. For example, Defence has provided Ministers with unrealistic estimations of the capacity of the M113 production facilities at different points in time. This is particularly evident in the June 2009 Ministerial submission seeking approval to extend the AM variant, which based the proposed production schedule on assembly rates already known by Defence to not be feasible, and had actually been advised to the previous Minister for Defence in December 2008. To better inform Ministers, there is a need for Defence to provide advice that is more closely aligned with project progress and conditions.

Table 4.2

Inaccurate advice to government on production schedule progress

Advice (topic)	Comments provided on schedule progress	ANAO comment
May 2008 Ministerial (recommending removal from Projects of Concern list)	<i>'Production at Bandiana is now being ramped up from approximately four vehicles per month to in excess of 10 vehicles per month to achieve the delivery of the final vehicle by December 2010'.</i>	Production was not 'now being ramped up'. Two vehicles per month on average were accepted during 2008. Production did not average over 10 per month until the period commencing November 2010. It was not until December 2008 that Defence advised of production rate problems: that 12 vehicles a month (the basis of the schedule agreed as part of the ELF approval) was not possible at Bandiana.
June 2009 Ministerial (proposal to extend mortar variant)	A table in the submission shows that Bandiana has the capacity to produce 12 vehicles per month.	Bandiana was unable to meet this rate of production, which was known by Defence and advised to the previous Minister in December 2008.
June 2010 Ministerial (on project progress)	<i>'[the Prime Contractor] is 40 vehicles behind schedule and this will grow to 75 vehicles by December 2010, before production efficiencies can start to reduce the backlog'.</i> <i>'[the Prime Contractor] remains committed to deliver all vehicles by April 2012 as contracted; however, it is likely that three to six months schedule slip will occur ... [the Prime Contractor] has agreed to propose a revised schedule by 23 July 2010'.</i> <i>'a total of 90 vehicles have been delivered to 1 Brigade'.</i>	As at end June 2010, production was 83 behind the contracted schedule at that time, 145 behind the 2007 global settlement schedule. As at end December 2010, production was 138 behind the contracted schedule at that time for all 431 vehicles, 158 behind the global settlement schedule for the original 350. A revised schedule was not agreed until August 2011. During fieldwork for the audit, 1 Brigade staff informed the ANAO that as at June 2010 1 Brigade had received a total of 46 vehicles. In response to the proposed audit report, Defence informed ANAO that this data was incorrect and that 90 vehicles had been provided to 1 Brigade as at that date.

Advice (topic)	Comments provided on schedule progress	ANAO comment
February 2011 Ministerial (on schedule slippage)	<i>'The DMO continues to collect Liquidated Damages against the contracted schedule and is negotiating with [the Prime Contractor] to have it deliver against the contracted obligations and minimise schedule slippage.'</i>	DMO was not continuing to collect liquidated damages against the contracted schedule. In August 2011, DMO agreed not to claim accumulated liquidated damages against the Prime Contractor for schedule delay as part of the contract renegotiation outcomes.
April 2011 Ministerial (on schedule delays)	<i>'A Gate Review into the M113 Upgrade Project was held in late October 2012.'</i> <i>'Negotiations commenced on 21 February 2011 with [the Prime Contractor] to resolve the contractual issues in dispute, primarily the Contractor's delay claims, and agree on a realistic contract production schedule. These negotiations are scheduled to conclude by the end of April 2011. DMO continues to negotiate, with all delay claim issues on the table, to ensure the earliest possible delivery of the capability.'</i> <i>'As of 15 March 2011, [the Prime Contractor] is currently 160 vehicles behind the contracted schedule, having delivered 207 vehicles out of 431'.</i>	A Gate Review on the M113 Upgrade had not been conducted in October 2011. (see paras 4.60–4.65) Negotiations were concluded in August 2011. 204 vehicles had been accepted by DMO as at 15 March 2011, 138 behind the then contracted schedule.

Source: ANAO analysis of Defence advice to government.

Recent advice to Ministers

4.60 In response to a February 2011 brief on project schedule delays, the Minister for Defence asked whether the M113 upgrade project should be put back onto the Projects of Concern list.¹⁸⁹ The Minister for Defence Materiel also canvassed the merits of undertaking a Gate Review for the project (see footnote 176 for a definition of Gate Reviews). On 5 April 2011, Defence prepared a submission that advised the Ministers that a Gate Review had been conducted in late October 2010 and another was scheduled for May 2011. Defence's submission also commented that:

¹⁸⁹ The current Projects of Concern process was established by the Government in 2008 to focus the attention of Defence and industry on remediating projects with significant schedule, cost, capability or project management challenges (see speech by the Hon. Stephen Smith MP Minister for Defence, *Defence and Industry Conference 2011 Opening Address*, 29 June 2011). The M113 upgrade project was on an initial list of Projects of Concern, which was compiled in December 2007, and was removed from the list in May 2008.

The compressed schedule resulting from global settlement was aggressive and shows that Tenix Defence's schedule and Defence's review was overly optimistic. This was clearly identified as early as 27 March 2009 by the ANAO in Audit Report No. 27 *'Management of the M113 Armoured Personnel Carrier Upgrade Project.'*

4.61 Defence further informed the Ministers that, because of the negotiations then ongoing with the Prime Contractor, 'it is too early to consider whether the M113 Upgrade Project should be put back onto the Projects of Concern list', and consideration should be delayed until after the completion of contract negotiations.

4.62 In May 2011, the ANAO requested copies of any Gate Reviews conducted in relation to the M113 upgrade project. ANAO was provided with a November 2010 document (*Brief for HLS – PBS BEs Project Review November 2010*), as the most recent DMO Gate Review, and was advised that the next review was scheduled for July 2011. The November 2010 document is not a Gate Review, but rather a DMO annual Budget Estimates review of the project.

4.63 The incorrect advice to the Minister that a Gate Review had been conducted provided unwarranted weight to this advice. DMO's Gate Reviews have developed an increasingly high profile, including in public discussion of Defence acquisitions. The Joint Committee of Public Accounts and Audit noted, in late 2008, the evidence of the then CEO, DMO before the Defence Subcommittee of the Joint Standing Committee on Foreign Affairs, Defence and Trade about 'the new steps being taken to mitigate risk through the gate review process'.¹⁹⁰ In later evidence to this Parliamentary Committee, DMO has identified Gate Reviews as a 'process to thoroughly flush out all of the issues' associated with a troubled project.¹⁹¹

4.64 Ministers have now developed high expectations of Gate Reviews and perceptions of their value. For example, the Minister for Defence stated, in July 2011:

Government is expanding the use of the Gate Review process for mature projects to ensure that the desired operational capability is being delivered.

¹⁹⁰ Joint Committee of Public Accounts and Audit, Report 411, *Progress on equipment acquisition and financial reporting in Defence*, August 2008, p. 136.

¹⁹¹ Evidence provided by the CEO, DMO, to the Joint Standing Committee on Foreign Affairs, Defence and Trade, Defence Subcommittee, Review of the Defence Annual Report 2009–10, Hansard, 25 March 2011.

Gate Reviews commenced in 2009 for selected high value and highly complex projects and have proven very effective in the early identification and resolution of problems.

Gate reviews have now been expanded to apply to all major capability projects.¹⁹²

4.65 In response to the proposed audit report, Defence informed the ANAO that incorrectly informing the Minister that a Gate Review had been conducted was a 'simple administrative error'. The ANAO is currently conducting an audit of the DMO Gate Review process.

4.66 On 23 April 2011 the Minister for Defence sought a further briefing on the project from the CEO DMO, the Chief of the Defence Force and the Chief of Army. DMO informed the ANAO that in response to the Minister's request a meeting was held but that there was no associated documentation.

4.67 According to a September 2011 ministerial submission, on 6 April 2011 (a day after the CEO DMO signed off on the April submission to the Minister) Chief of Army grounded the M113 fleet after braking failures resulted in a soldier at 7 RAR being struck by a vehicle (see Chapter 5 for more explanation on the fleet grounding). As at March 2012, the last ministerial submission provided was in November 2011. This submission reported on technical problems being experienced by the M113 vehicles, noting that these problems required further investigation, and that vehicles are not to be used until proper inspections have been conducted. Problems keeping the vehicles' track links in place meant that that fleet could only drive at low speed until further notice, which prevents their use on public roads.

4.68 The Minister was updated on schedule delay issues and the Chief of Army's grounding of the M113 fleet in the September 2011 ministerial submission. As part of the brief, there were several comments made about the project's progress which indicated that, notwithstanding the ongoing schedule slippage and delays to vehicle production, the project should not be placed on the Projects of Concern list (see Table 4.3).

¹⁹² Speech by the Minister for Defence to the Australian Strategic Policy Institute, Canberra, 19 July 2011.

Table 4.3

September 2011 ministerial on project progress

Statement	ANAO comment
<i>In-service delivery commenced approximately 12 months behind schedule due to technical problems in development and during testing. Ultimately, the technical issues resulted in a global settlement in 2007.</i>	While technical issues did delay the development of the fleet, a global settlement was needed because the Contract was not fit to be used as a mechanism for resolving the technical issues. Key deficiencies included a lack of specification of payloads, inadequate prioritisation of requirements, and ambiguous liquidated damages provisions.
<i>The project was included on the Projects of Concern list in 2006.</i>	The Projects of Concern list was established in December 2007, with LAND 106– the M113 Upgrade project being on the original list (see footnote 189).
<i>In late 2007, these technical risks were retired with the successful completion of extensive reliability and acceptance testing. Approval for production readiness was achieved in November 2007. As the project was proceeding well and vehicle production had commenced, the DMO received Ministerial approval to remove the project from the Projects of Concern list in May 2008.</i>	There was little basis for the judgement at the time that the production was proceeding well. As noted in Table 4.1, vehicle production averaged two per month in 2008. As at May 2008, only 16 vehicles had been delivered to Army, and only three of the seven variants had passed their PRRs.

Source: ANAO analysis of 7 September 2011 Ministerial, *M113 Upgrade Project – Schedule Delay and Grounding of the M113AS4 Armoured Personnel Carrier Fleet*.

4.69 The inaccuracies and inconsistencies in reporting on this project that has occurred over time can be attributed, in part, to a lack of appropriate schedule analysis by DMO throughout the later stages of the project. A lack of detailed understanding of project progress and schedule issues has been an ongoing feature of this project, as advised to the Minister in February 2011:

Since taking over the contract, following its acquisition of Tenix Defence in 2007, [the Prime Contractor] has had difficulty attaining the required production rate of vehicles to achieve the contracted schedule ...

In March 2010, [the Prime Contractor] advised it would not meet the contracted vehicle delivery schedule. Since then, the DMO has been endeavouring to gain clarity of [the Prime Contractor's] real schedule position in order to assess the consequences and advise Army and Government. Gaining clarity of the schedule has been difficult.

5. Upgraded M113 Capability

This chapter assesses the level of capability that has been achieved to date for the upgraded M113 fleet, through examining progress in generating the fundamental inputs to capability required to establish and maintain the fleet at the Army's desired operational readiness.

Introduction

5.1 The previous two audits of the upgrade of the M113 fleet, chiefly focused on the management of the relevant contracts and the production of the upgraded M113 vehicles. The 2008–09 audit also examined the achievement of initial capability. This audit sought to identify the level of capability¹⁹³ this fleet of vehicles has achieved so far.

5.2 Originally intended as an interim measure to provide Army with 'a cheap and cheerful upgrade,'¹⁹⁴ and an adequate close-combat mechanised infantry capability until the introduction of the next generation of infantry vehicles, the M113 upgrade project has subsequently undergone scope changes that have expanded the project's deliverables and the expected capability to be generated. As discussed in Chapter 1, the M113 upgrade project stems from the 2000 Defence White Paper, which set out requirements for:

...land forces that can respond swiftly and effectively to any credible armed lodgement on Australian territory and provide forces for more likely types of operations in our immediate neighbourhood.¹⁹⁵

5.3 The 2000 Defence White Paper capability requirement reflected the operational environment before the terrorist attacks in the United States of 11 September 2001, and prior to Australia's involvement in military operations in Afghanistan and Iraq. In the pre-September 2001 environment, the major upgrade project was originally intended to contribute to the capability outlined in the 2000 White Paper through the provision of 350 upgraded M113s at a cost

¹⁹³ As previously mentioned, capability involves combining the multiple personnel, equipment and support system inputs that are codified by Defence in the Fundamental Inputs to Capability (FIC—set out in detail at Table 5.1 and Appendix 1).

¹⁹⁴ Defence, cited in ANAO Audit Report No.27 2008-09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, p. 71.

¹⁹⁵ Department of Defence, 2000, *Our Future Defence Force*, Commonwealth of Australia, Canberra, 2000, pp. 77–78.

of \$500 million, scheduled to enter service in 2005. In response to the 2000 White Paper, Defence concluded that the upgraded vehicles were fundamental to its required capability, and the then Government approved the major upgrade at a revised cost of \$593.95 million, with a revised introduction into service date of 2006, without specifying a date for the final delivery of all vehicles.

5.4 In 2008, the Government approved funding for the Enhanced Land Force initiative (ELF), which created a new mechanised infantry battalion, the 7th Battalion Royal Australian Regiment (7 RAR). To implement ELF, Defence sought approval from the Government to acquire an additional 81 upgraded vehicles at a cost of \$222.1 million (2008–09 Budget prices), bringing the total to be acquired under the project to 431. Defence advised the Government that the vehicles would allow both 5 and 7 RAR to be fully equipped with upgraded M113s and avoid the need for mixed fleets including Bushmasters and ASLAVS. Defence justified the purchase of the additional upgraded M113s on the basis that:

- the upgraded M113s provided superior protection in comparison to the Bushmaster and ASLAV;
- the vehicles could be deployed to Iraq and Afghanistan with relatively low-cost upgrades; and
- the vehicles could withstand heavy machine gun fire.

5.5 The first upgraded M113s entered service in late 2007. At the time the Government approved the acquisition of the 81 ELF vehicles, all 431 vehicles were originally intended to enter service by July 2011.

5.6 Within a year of the ELF decision, the 2009 Defence White Paper restated Australia's strategic position and identified four key tasks for the ADF, of which the foremost was to deter and defeat armed attacks on Australia. The ADF's second priority was to assist in providing security and stability to the South Pacific and East Timor, the third to provide military assistance to the Asia-Pacific region, and the fourth priority was to provide military assistance to the international community. The upgraded M113s are intended to contribute to the ADF's first two priorities and, in particular, to the defence of northern Australia, in the specific role of close-combat vehicles for the Army's two mechanised infantry battalions.

Achieving the required capability

5.7 ADF doctrine sets out levels of capability to be achieved and the inputs necessary to achieve capability. Three levels of capability are set out in *Preparedness and Mobilisation (Provisional)*, an Australian Defence Doctrine Publication issued in 2004 under the authority of a Defence Instruction (General).¹⁹⁶ These are:

Operational level of capability (OLOC), the mission-specific level of capability required by a force to execute its role in an operation at an acceptable level of risk. OLOC is achieved and maintained at high cost. It is not realistic to maintain all forces at high-levels of preparedness for all possible contingencies. Consequently, only those elements required to deal with short notice contingency requirements are maintained at this level.¹⁹⁷

Directed level of capability (DLOC), the funded average level of capability maintained during a specified budget period, normally a financial year. It is formally agreed in organisational performance agreements (OPA) between the Secretary/CDF and each of the [*Outcome Executives*¹⁹⁸] and provides the mandatory link between activities and annually allocated financial resources. DLOC captures the levels of capability to be maintained to meet preparedness, ongoing operations, and known national task requirements. It is expressed in terms of assigned [*Force Elements*], tasks, authorised readiness and sustainability requirements against each [*operational preparedness objective*].¹⁹⁹

Minimum level of capability (MLOC), the lowest level of capability from which [*a Force Element*] can achieve its operational level of capability (OLOC) within readiness notice (RN), and it encompasses the maintenance of core skills, safety and professional standards. It is a term employed only within the six [*Outcome Executives*].²⁰⁰

5.8 OLOC and DLOC articulate the balance required to maintain forces at a level of preparedness commensurate with available financial resources, while recognising operational resource requirements. Such forces must be ready to

¹⁹⁶ Department of Defence, *Preparedness and Mobilisation (Provisional)*, ADDP 00.2, Canberra, 2004, currently valid under the authority of Defence Instruction (General) ADMIN 20–1, *Australian Defence Force Joint Doctrine*, revised 30 January 2008.

¹⁹⁷ *ibid.*, p. 1–7.

¹⁹⁸ There are six Outcome Executives: HQ Joint Operations Command; Navy; Army; Air Force; Intelligence and Security; and Strategy.

¹⁹⁹ *Preparedness and Mobilisation (Provisional)*, *op. cit.*, Glossary, p. 3.

²⁰⁰ *ibid.*, Glossary, p. 6.

work-up to an appropriate higher level of capability, in a given time frame and with the necessary resources, in order to conduct specified operations effectively.²⁰¹

5.9 Put another way, DLOC is an agreed and funded level of capability based on government strategic and financial guidance, an explicit agreement on the extent to which OLOC will not be reached for budgetary reasons. In this respect, DLOC:

provides the linkage between an agreed level of preparedness and an agreed price for that level.²⁰²

5.10 DLOC is outlined in the annual Organisational Performance Agreements between the Secretary/CDF and each of the three Service Chiefs.²⁰³ It is promulgated through (at the highest level) the Chief of the Defence Force Preparedness Directive, the Joint Operations Command Operational Preparedness Requirement, and through subordinate directives to lower-level ADF units.²⁰⁴

5.11 The achievement of OLOC, DLOC and MLOC is determined by reference to the framework of Fundamental Inputs to Capability (FIC). The FIC are the component personnel, equipment and support systems that enable Defence to effectively deploy and sustain its forces. They are set out below in Table 5.1 and include, for example, the systems and arrangements for training personnel, administering equipment parts and spares and conducting maintenance, as well as those for overseeing and planning operations and exercises.

²⁰¹ *ibid.*, p. 1–6.

²⁰² *ibid.*, p. 1–8.

²⁰³ The ANAO has previously observed that, in some circumstances, a unit is directed to achieve a level of preparedness that is *below* MLOC, and that these deficiencies may remain for several years. See ANAO Audit Report No.25 2004–05, *Army Capability Assurance Processes*, p. 30.

²⁰⁴ *ibid.*, p. 1–7.

Table 5.1

Fundamental Inputs to Capability—the FIC Framework

Component Inputs
Major Systems: those systems that have a unit cost of \$1m or more, such as armoured personnel carriers. Major systems are core components of capability that regularly require more detailed reporting and management.
Facilities: buildings, structures, property, plant and equipment, and areas for training and other purposes, as well as utilities and civil engineering support.
Supplies: there are 10 classes of supplies, many of which need more consideration than just quantity (for example serviceability, configuration and operational viability).
Support: a broad category that involves support to all areas of Defence, from communications and IT to research and development to administrative and logistical support. Support services may be provided by external organisations.
Personnel: personnel who satisfy the necessary readiness requirements and have the competencies to perform the functions of their positions (skilled in performing both specialist and common military tasks).
Organisation: the required personnel establishment, correct structure and the appropriate balance of skills.
Collective training: a comprehensive and on-going collective training regime validated against preparedness requirements.
Command and Management: command and decision-making process and procedures at all levels of Defence needed to plan, apply, measure, monitor and evaluate agency functions. Command and management include written guidance such as instructions, directions and doctrine.

Source: Department of Defence.

5.12 Capability is therefore more than solely having available a core component or a major system such as the fleet of upgraded M113s. Such a fleet generates the required capability when Defence can bring to bear inputs such as trained operators and maintainers, spare parts and maintenance equipment, and the administrative apparatus necessary to integrate the fleet into its planning and operations. The practical effect of this doctrine is that, while major systems of materiel may be delivered and individually functional, they

do not provide the required capability unless all other fundamental inputs to capability are present.

5.13 The audit approach to considering the capability of the upgraded M113 fleet was based on the requirements of the FIC framework. The ANAO examined the capability achieved by the upgraded M113 fleet in relation to the four elements of the FIC most relevant to this stage of the vehicles' introduction into service:²⁰⁵

- major systems;
- facilities;
- supplies; and
- support.

Major Systems

5.14 The upgraded M113s constitute the major system which, to be effective, must be delivered and achieve an acceptable level of availability. In order to assess levels of vehicle availability, the ANAO examined vehicle log records for upgraded M113s in use with 7 RAR, and found that actual vehicle use was relatively low. The highest M113 odometer reading at 7 RAR as at 21 February 2011 was 600 kilometres, considerably less than for the upgraded M113s at the School of Armour, where the average odometer reading at the end of 2010 was 5180 kilometres, with an average of 483 engine hours.

5.15 The School of Armour is located at the Army's Puckapunyal base in Victoria and is responsible for training soldiers in the operation of the upgraded M113 and for the ASLAV and Bushmaster, which are Army's other fleets of armoured vehicles. Army informed the ANAO that the School of Armour records would provide an accurate picture of how the upgraded M113s perform under combat conditions, since the vehicles are in constant use and are driven to the limits of their operating capability.

5.16 Audit analysis of vehicle availability is therefore based on the vehicle records of the School of Armour, as these are likely to give a better indication of overall reliability and availability than the records relating to the relatively

²⁰⁵ The ANAO focused on these four elements of the FIC on the advice of Defence, at the commencement of the audit, that the other FIC elements would not be fully developed until the fleet achieved its Minimum Level of Capability (MLOC), when the last AM was delivered.

low-use vehicles stationed with 7RAR. The ANAO examined M113 maintenance records for the School of Armour covering the period 19 February 2008 to 1 December 2010 to ascertain:

- the serviceability of the M113 fleet at School of Armour; and
- the main factors affecting the serviceability of the School of Armour M113 fleet.

5.17 The maintenance records include useability codes that classify each upgraded M113 as 'Fully Functional' (FF), 'Restricted Use' (RU), or 'Unserviceable' (XX). The *Technical Regulation of ADF Materiel Manual – Land* defines useability codes for the functional state of materiel and any restrictions on materiel use, as shown in Table 5.2.

Table 5.2

Vehicle useability classifications and codes

Vehicle useability classifications
<p>Fully Functional (FF)</p> <p>The materiel meets technical integrity requirements for all specified operating conditions. It is safe to operate, is maintained and has acceptable wear within defined limits. It may have outstanding maintenance or modifications which do not affect safe operation.</p>
<p>Restricted Use (RU)</p> <p>The materiel is unable to perform the full range of specified tasks. It may have outstanding maintenance or modifications which do not affect specified safe operation. It must be capable of performing tasks within specified restrictions without unacceptable risk of personnel injury, equipment or environmental damage.</p>
<p>Do Not Use – XX (XX)</p> <p>Continued use of the materiel is not possible, or poses an unacceptable risk of personnel injury, equipment or environmental damage. Before further use, technical maintenance is required to restore the useability code of the materiel to FF or RU. Materiel coded XX is to be clearly marked as such, in a manner obvious to users.</p>

Source: Department of Defence, *Technical Regulation of ADF Materiel Manual – Land*, 2009.

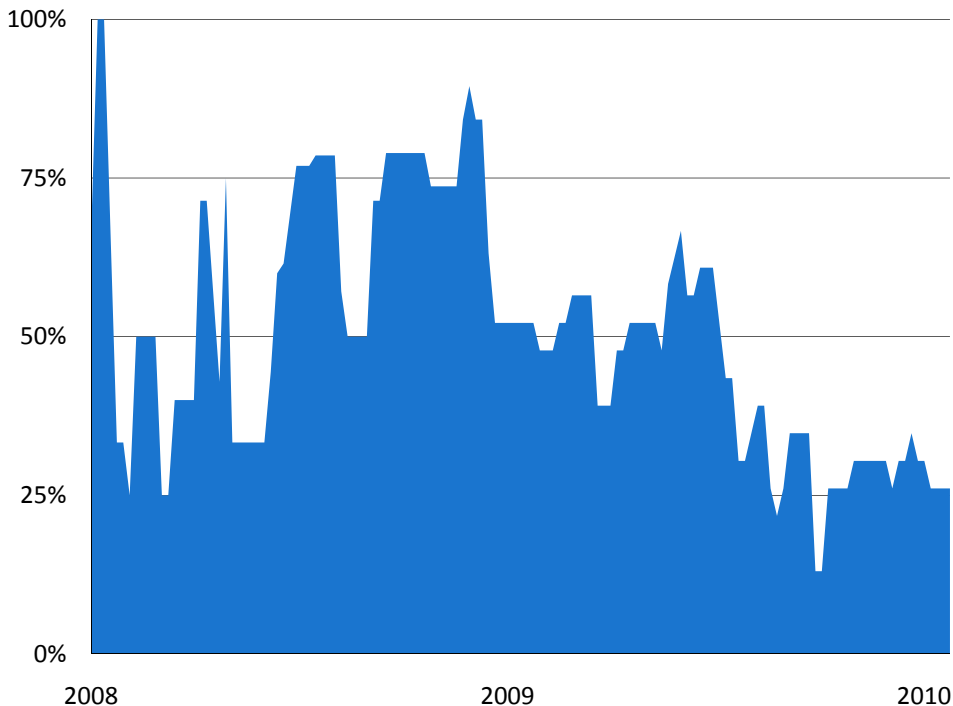
5.18 The data indicate that, over the three years to December 2010,²⁰⁶ the proportion of vehicles at the School of Armour classified as Fully Functional decreased from an average of 62 per cent in 2008 to 38 per cent in 2010, as

²⁰⁶ Defence was unable to provide trend data for the period after December 2010, however, informed ANAO as at March 2012 that the percentage of 'Fully Functional' vehicles for the upgraded M113 fleet was 39 per cent, 'Restricted Use' was 37 per cent, and Not to be Driven (XX) was 24 per cent. Defence identified that this was above the minimum requirement that 75 per cent of the fleet be classed as at least 'Restricted Use'.

shown in Figure 5.1. This decline in Fully Functional vehicles was accompanied by an increase in Restricted Use vehicles awaiting repairs that required spare parts.

Figure 5.1

Percentage of Fully Functional upgraded M113s in the fleet, 2008–2010



Source: ANAO analysis of Defence data.

5.19 The data indicated that the main factors affecting availability were a lack of spare parts (discussed at paragraph 5.25), and mechanical failures associated with design features of the upgraded M113s (discussed at paragraph 5.31).

5.20 More fundamentally, achieving full capability entails the production and delivery of the full suite of variants and all 431 vehicles. Chapter 3 of this report (Figure 3.6) highlighted that the project has some way to go before this is achieved. The Minimum Level of Capability (MLOC) was originally to be achieved by 31 December 2010, though continuing delays in the roll-out of the upgraded M113s have been a key factor that has prevented Army from achieving MLOC. MLOC is now expected to be achieved by December 2012.

Facilities

5.21 Facilities include buildings, structures, property, plant and equipment, and areas for training. The ANAO visited several facilities relating to the operation of the upgraded M113 fleet including:

- the School of Armour training facility at the Army's Puckapunyal base in Victoria;
- the 7th Battalion Royal Australian Regiment at Edinburgh Barracks in South Australia (established in January 2011)²⁰⁷; and
- the Cultana training facility located near Port Augusta in South Australia.

5.22 7 RAR's Edinburgh headquarters is a modern facility, encompassing administration, storage and workshop facilities. Defence informed ANAO that the Edinburgh facility is suitable for the Battalion, and the workshops have the capability to allow the Battalion to undertake all of the required maintenance of its current fleet of upgraded M113s. It is some 300km from the Army's Cultana training facility, which is well-suited to year-round mechanised infantry training.²⁰⁸

5.23 The ANAO visited the School of Armour in November 2010. While the School's facilities were adequate to support the training required, Defence informed the ANAO that its ability to meet training demands was hampered at the time by a shortage of Fully Functional vehicles and by the number of vehicles classified as for Restricted Use.

Supplies

5.24 The Fundamental Inputs to Capability identify ten classes of supplies, from which the ANAO selected two classes for examination that are specific to the upgraded M113 vehicles achieving capability:

- class 7 supplies – principal items (which includes items such as small arms, communications equipment, and training); and

²⁰⁷ Under the ELF initiative, Army's only mechanised infantry battalion 5/7RAR, based in Darwin, was disbanded in 2009. 5 RAR and 7 RAR were reformed in 2009, and 7RAR relocated, during January 2011, from Darwin to the ADF's Edinburgh establishment in Adelaide. The ANAO visited 7 RAR's new headquarters in February 2011.

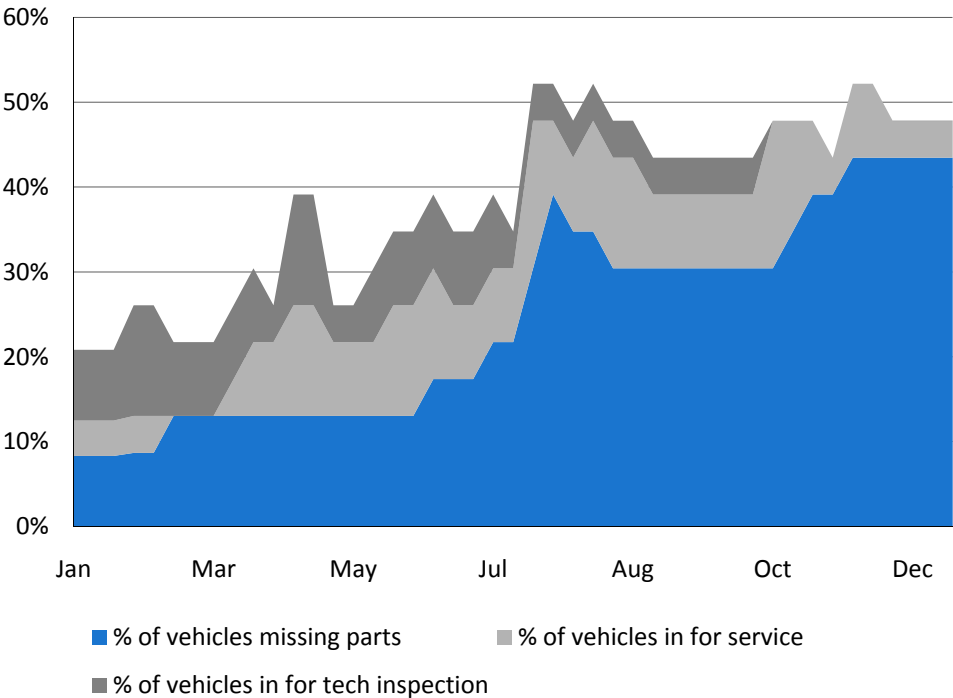
²⁰⁸ The utility of training areas located in the Northern Territory is affected by seasonal weather conditions, notably during the wet season, when training areas can be flooded, inaccessible or unusable.

- class 9 supplies – repair parts and components.

5.25 The ANAO found adequate class 7 supplies were available to the relevant army units, with the important exception of communications equipment, discussed from paragraph 5.27. However, this was not the case for class 9 supplies, which are critical to the operation of the vehicles, as they are required in order to maintain the vehicles’ mechanical capability. As mentioned at paragraph 5.19, shortage of repair parts and components has meant that a significant number of vehicles were out of service, or available only for restricted use, at the time of ANAO fieldwork. Analysis of the maintenance records of the School of Armour, based on the latest available data, showed that at the end of 2010, the number of vehicles marked Not for Use (XX) or for Restricted Use (RU) because they needed replacement parts had risen to more than 40 per cent of upgraded M113s, as shown in Figure 5.2.

Figure 5.2

Reasons for unserviceability of vehicles at School of Armour, 2010



Source: ANAO analysis of Defence data.

Support

5.26 Support is a very broad category of input to capability, within which the ANAO focused on those elements that are critical to establishing and maintaining the upgraded M113 capability, particularly:

- communications;
- maintenance services; and
- logistics.

Communications

5.27 The ability of an upgraded M113 crew to communicate with other vehicles, command and support elements is an essential part of the vehicles' capability. In particular, it enables operations in concert with tanks and other ground forces, including artillery. The upgraded M113 uses the Army's standard Raven communications system, adapted to the upgraded M113 through an item of equipment known as the VIC 3 harness. The VIC 3 harness was installed in the original M113s, but Defence informed the ANAO that it is no longer in production.

5.28 The VIC 3 harness is also standard equipment on the Army's other infantry armoured vehicles, the ASLAV and the Bushmaster. Army informed the ANAO that there is a limited number of VIC 3 harnesses, and these are rotated across the three fleets of infantry vehicles, and between vehicles within each fleet. The highest priority is given to fitting VIC 3 harnesses to ASLAVs and Bushmasters, as they are currently deployed to Afghanistan.

5.29 The knock-on effect is a shortage of VIC 3 harnesses for upgraded M113s. The limited number of harnesses and the ADF's ongoing commitment to Afghanistan limits the Army's ability to conduct training exercises with the desired complement of upgraded M113 vehicles, and renders a number of vehicles inoperable due to a lack of communications. Army advised that with the introduction of the new SOTAS²⁰⁹ communications system into other vehicle types currently carrying the VIC 3 harness, an increased number of VIC 3 harnesses will become available for the upgraded M113 fleet. Army expects to have all upgraded M113s fitted with VIC 3 harnesses by December 2012.

²⁰⁹ SOTAS is the next generation of vehicle communication harnesses, and will be compatible with Army's Land 75 project. See footnote 64.

Maintenance services

5.30 As discussed earlier, the ANAO conducted site visits to two of the four Army facilities currently operating the upgraded M113; the School of Armour at Puckapunyal, Victoria; and Headquarters 7 RAR, at Edinburgh, South Australia. The maintenance facilities at the School of Armour are operated by the same Prime Contractor conducting both the major upgrade and CSP Contract. The facilities at 7 RAR are operated by staff of the Royal Australian Electrical and Mechanical Engineers.

5.31 ANAO analysed the relevant School of Armour maintenance records, based on the latest available data, and identified the common causes of maintenance problems (set out in Table 5.3). These include hydraulic failures or malfunctions, failures of the scavenge fan intended to circulate cooling air through the engine compartment, and problems with brakes, controls, turret operations and hatches. The cooling, brake and hydraulic problems appear to be a continuation of design issues identified early in the life of the project.

Table 5.3

Common maintenance problems from initial introduction into service in November 2008 to 11 November 2010

Problem	Number of occurrences
Crane problems: hydraulic pump, not tested, other	138
Scavenge fan	116
Brake problems: vehicle quarantined, fluid leaks, broken brake actuator, other	88
GPS problems: power cable, other	84
Hand controller	73
Turret problems: electrical faults, lock, other	72
Command hatch	54
Driver's hatch	54
Night sight	53

Source: ANAO analysis of Department of Defence data.

5.32 The previous audit noted a history of brake failures with the upgraded M113s since their initial Reliability and Qualification Testing in March 2006.²¹⁰ Although the specific technical issues leading to these failures were considered by Defence to have been resolved when the APC variant passed its PRR in late 2007, other, further failures have subsequently occurred. In April 2011, the entire fleet was grounded due to cracks occurring in the vehicles' brake reservoirs, leading to brake failure, and in at least one instance, causing injury to personnel. Investigations by DMO found the cracking in the reservoir was caused by defective welding by the manufacturer (a third party to the Prime Contractor). However, this finding has been disputed by the manufacturer, which claims that the failures were caused by blockages within the braking system, and the failures are a maintenance issue for Army, as opposed to a manufacturing defect. The Prime Contractor subsequently conducted a risk assessment and classified the brake reservoir failure as 'low risk', but proceeded to replace the affected brake reservoirs.

5.33 DMO wrote to the Prime Contractor in December 2011 disagreeing with the manufacturer's diagnosis, and the Prime Contractor's risk assessment. DMO requested the Prime Contractor to investigate whether the manufacturer is 'a quality accredited company and that they have the processes in place to ensure that the delivery of non-conforming product does not continue.' While Army has suitable facilities to conduct maintenance on the upgraded M113, the significant number of vehicles with mechanical problems, notably at the School of Armour, had resulted in a backlog of vehicles awaiting repair or service. In particular, the upgraded M113 at the time of audit fieldwork required an oil change every 200 hours (or 5000km) involving the removal, service and re-fit of the engine and gearbox. The demands of the 200-hour service exacerbated the backlog of existing work to repair vehicles, reducing overall levels of vehicle availability.²¹¹

Logistics

5.34 Logistics capability encompasses the ability to move the upgraded M113s within Australia, and to deploy them overseas. The upgraded M113 is a heavy vehicle with a gross vehicle mass of some 18 tonnes and dimensions

²¹⁰ ANAO Audit Report No. 27 2008-09, *Management of the M113 Armoured Personnel Carrier Upgrade Project*, p. 82.

²¹¹ Defence informed the ANAO that the '200 hour oil change is soon to be removed as a maintenance requirement and rolled into the 400 hour oil change and valve adjustment' service.

similar to those of a light truck. In common with most tracked vehicles, they are relatively slow when travelling on made roads, with high rates of fuel consumption and the potential to significantly degrade the road surface. Consequently, dedicated, specialised transport equipment is used for the overland transport upgraded M113s over any significant distance.

5.35 Within Australia, upgraded M113s are usually transported by truck, and in some cases, by train. The Army's present heavy lift road transport capability is being restructured under the Land 121 project. Army is currently able to transport the upgraded M113 by road using its heavy tank transport capability and through the use of civilian contractors. The upgraded M113's predecessor could be transported using Army's existing fleet of three-axle rigid trucks. However, due to the increased weight of the upgraded M113 this is no longer possible without exceeding the trucks' recommended gross vehicle mass.

5.36 Deploying upgraded M113s overseas requires transport by sea or air. Australia's native air lift capability currently comprises the Royal Australian Air Force's C130 and C17 transport aircraft. In order to transport the upgraded M113s, Defence is currently designing a loading ramp system for the C130 to withstand the vehicles' increased weight. Army advised that this capability should be in place by December 2012.²¹² The C17 aircraft is capable of transporting four of the upgraded vehicles, however, the Chief of Army informed ANAO in April 2012 that the C17 has yet to be certified to undertake this task.

5.37 Australia's native amphibious assault capability currently comprises HMAS *Tobruk* (which recently underwent extensive maintenance to extend its life until 2015),²¹³ and HMAS *Choules* (purchased from the United Kingdom Ministry of Defence and currently being brought into service).²¹⁴ Army informed ANAO that it may be possible to transport the upgraded M113 from

²¹² Testing of this loading ramp system commenced in March 2006 and as of April 2012 had not been certified. The system involves 'chocking' the rear of the plane and its loading ramp with numerous planks of wood. In order to meet the maximum weight requirements of this system, the upgraded M113 has to be stripped of its appliqué armour, and all of its munitions and stores.

²¹³ In April 2012, the Chief of Navy stated that HMAS *Tobruk* was 'in the latter part of its life and its availability can be considered fragile'. See Chief of Navy, *Letter to the Editor of the Canberra Times*, 1 April 2012.

²¹⁴ Navy's two Landing Platform Amphibious (LPA) vessels HMAS *Manoora*, and HMAS *Kanimbla* were decommissioned during 2011 due to their poor hull conditions.

HMAS *Choules* to shore using Navy's existing LSM8 vessel, or the vessel's ship-to-shore transport system, but this capability is yet to be tested for the upgraded M113.

5.38 In addition to HMAS *Choules*, Navy currently plans to introduce two new amphibious platforms from 2014, in the form of the Canberra class heavy amphibious platforms (also known as Landing Helicopter Docks, or LHDs).

Coordination of the FIC

5.39 As previously discussed, capability is the capacity or ability to achieve an operational effect through the successful coordination of all required FIC elements. The upgraded M113 is a vital element, though not the only element, required for the ADF to undertake close-combat mechanised infantry operations. The level of capability so far delivered under the M113 upgrade project has been affected by the lack of coordination of all required FIC elements, especially the transport and communications elements. As a result, there are significant limitations on the ADF's ability to readily transport the upgraded M113s, and limitations on their ability to communicate effectively on the battlefield with other major ADF combat platforms.

5.40 ANAO notes that the upgraded M113 is not an isolated case. Another recent instance where coordination of essential inputs to capability has been less than optimal was the sub-standard maintenance of the Navy's heavy-lift ships. The logistic underpinnings of materiel systems are integral to achieving capability and require attention throughout the capability life cycle.

5.41 From March 2010, Defence introduced Joint Project Directives as one of the primary governance documents for all new major capital acquisition projects. These Directives aim to identify the FIC elements that need to be delivered in order for each project to deliver the desired level of capability. To adequately coordinate the relevant FIC, each project's Joint Project Directive should be reviewed, at least annually, to review progress in developing the required FIC elements. Similarly ANAO would expect Defence to review on at least an annual basis projects that commenced prior to March 2010, and so are not governed by Joint Project Directives, to identify the relevant FIC required to deliver capability, and the progress in developing these FIC elements.

Recommendation No.1

5.42 The ANAO recommends that, to maintain a focus on the delivery of the Fundamental Inputs to Capability (FIC) for each major capability project, including FIC elements to be delivered under other capability projects, Defence review at least annually the progress in developing FIC elements for each major capability project detailed in Joint Project Directives.

Defence Response: Agreed.

Overall upgraded M113 capability

5.43 The upgraded M113 has not delivered the superior levels of protection originally sought and, at the time of this audit, was considered by Defence as probably not suitable for use in situations where close combat is expected on a daily basis²¹⁵. Certain key aspirations originally proposed by Defence for the upgraded M113 capability are yet to be achieved or have proved unachievable, as summarised in Table 5.4.

Table 5.4

Defence's capability aspirations for the upgraded M113 and its capability achievements as at December 2011

Capability aspiration	Capability achievement
Tracked vehicle with superior mobility in difficult terrain	Achieved: the upgraded M113 was observed to provide superior mobility to that of wheeled vehicles when operating in difficult terrain.
Improved survivability	Achieved: The upgraded M113 runs on diesel rather than petrol, significantly reducing the risk of fire compared to the original M113.
Able to withstand heavy machine gun fire	Achieved
Efficiency in developing new capability	Not achieved: The project has suffered significant delays with the design for the final variant, the AM, only being finalised in September 2011.

²¹⁵ Joint Committee of Public Accounts and Audit Hansard, *Review of Auditor-General's Reports, Audit Report No. 27 2008-09 Management of the M113 Armoured Personnel Carrier Upgrade Project*, Commonwealth of Australia, p. 30. Defence subsequently advised the ANAO in March 2012, that the vehicle now has achieved close combat capability, despite no further protective modifications being made to the vehicle since Defence appeared before the JCPAA in June 2009.

Capability aspiration	Capability achievement
Close-combat capability	Not achieved: Defence advised the JCPAA in June 2009 that it would 'probably not [<i>use the upgraded M113</i>] in a place where there is sustained close combat expected on a daily basis'. ²¹⁶
Able to operate in concert with heavy tank capability	Partially achieved. The upgraded M113 has been involved in limited operations with tanks. Upgraded vehicles are not able to communicate effectively with tanks, as the tanks have a superior communications system which allows for the transfer of data. The M113 fleet is only capable of voice communication. ^{(A)(B)}
Superior protection in comparison to the Bushmaster and ASLAV	Partially achieved: The upgraded M113 has superior ballistic protection but a lower level of blast protection than the ASLAV and Bushmaster vehicles. ²¹⁷
Able to be deployed to Iraq and Afghanistan with relatively low cost upgrades	Partially achieved: Defence informed ANAO that the upgraded M113s are not suitable for these theatres.
Deployable by C130 Hercules aircraft	Yet to be achieved: The upgraded M113 is currently not certified to be transported by C130 Hercules.
Improved reliability	Yet to be achieved: The upgraded M113 has continuing mechanical problems and a low level of availability, which has resulted in the fleet being grounded several times. ²¹⁸ Defence informed ANAO that the upgraded vehicles are more reliable than their predecessor, but was unable to provide comparative data.

(A) Army originally expected to address the current communications limitations of the M113 by fitting to these vehicles the systems to be developed under projects LAND 75 and LAND 125. However, in the context of the 2012-13 Federal Budget, the relevant phases of the linked projects, Land 75 and Land 125, that were to deliver these capabilities into the upgraded M113 vehicles will not now proceed. However, Defence informed ANAO that consideration will be given to including the installation of these capabilities in the upgraded M113s under later phases of these projects.

(B) The Networking the Army Campaign Plan (NACP), identifies projects LAND 75 and LAND 125 as delivering the Army's core command and control systems. Together, these projects will provide Army with a Battle Group and below Command, Control and Communications (BGC3) System.

²¹⁶ Ibid.

²¹⁷ Defence has ordered a further 101 Bushmaster vehicles to support its operations in Afghanistan. This will increase the Army's complement of Bushmaster vehicles to 838 (Kerr, J., 2011, *Jane's Defence Weekly*, Volume 48, Issue 20, 18 May 2011, p. 13).

²¹⁸ The fleet was most recently grounded in November 2011, due to failures of the vehicles' tracks.

The BGC3 requirement is for soldiers and their vehicles to wirelessly exchange combat data and voice communications. This capability is planned to be delivered and operationally tested to enable the Commonwealth to achieve its Networked Centric Warfare Milestone – Initial Networked Land Force.

Generically the BGC3 System will consist of the following core sub-systems:

- a Battle Management System (BMS) for commanders, operators and HQ;
- a Combat Radio System (CRS) to provide voice and data services;
- a Network Management System (NMS) which will electronically integrate, configure, monitor and control the BMS and CRS;
- a Navigation System; and
- a Support System.

Source: ANAO analysis of Defence documentation.

5.44 This state of affairs reflects, in part, the length of time it has taken to bring the project to its current state of development, and the impact of the changes in the operational and strategic environment that have emerged since the project commenced. Approved prior to the changes in the threat environment arising from the 11 September 2001 terrorist attacks on the United States of America, the upgraded M113 was not intended to deal with emerging threats, such as improvised explosive devices, that have now become a feature of key operations. The level of protection sought at the commencement of the project, while commensurate with the anticipated threats of the time, is not sufficient now for deployment in the ADF's current theatres of operation.

5.45 Design issues have also hampered the achievement of capability. On the pathway of design and development of the upgraded M113, the vehicle has become heavier than originally anticipated, resulting in key logistics capabilities having to be redesigned to transport the vehicle.

5.46 Delays in achieving a capable design and the intended rate of production have led to substantial shortfalls in the delivery of the upgraded vehicle to Army. The upgraded M113 fleet was originally to have entered service in 2006. Following the 2007 contract negotiations, Defence intended achieving the Directed Level of Capability²¹⁹ by December 2010, though this is

²¹⁹ As described at paragraph 5.7, the Directed level of capability is the funded average level of capability maintained during a specified budget period, normally a financial year. It is formally agreed in organisational performance agreements (OPA) between the Secretary/CDF and each of the [*Outcome Executives*] and provides the mandatory link between activities and annually allocated financial resources. DLOC captures the levels of capability to be maintained to meet preparedness, ongoing operations, and known national task requirements. It is expressed in terms of assigned [*Force Elements*], tasks, authorised readiness and sustainability requirements against each [*operational preparedness objective*].

now scheduled to occur in December 2012, more than six years later than originally agreed by Government when the project was approved. The upgraded M113s are scheduled for replacement with more capable protected mobility under project Land 400 from 2025, so that the cumulative effect of the delays is to halve the upgraded vehicles' useful life from 14 years to seven years.

5.47 During the course of the M113 Upgrade Project, a new generation of armoured vehicles known as 'infantry fighting vehicles' has evolved—many of these vehicles are now in service with other armed forces. In comparison to these new generation infantry fighting vehicles, the upgraded M113 lacks fire power and other vital capabilities, giving rise to a capability gap in Army's close combat infantry operations. This capability gap has been acknowledged by the Acting Chief of Army:²²⁰

It is important to note that while the M113AS4 [*the upgraded M113*] is a capable combat vehicle, it does have constraints and limitations through design and capacity as it is based on the M113A1 hull. This factor limits its potential in comparison to higher order platforms including current generation [*infantry fighting vehicles*]. This fact essentially provides a capability gap for the conduct of close combat across the spectrum of conflict until the introduction into service of the Land Combat Vehicle System (Land 400).²²¹

5.48 As with the logistic underpinnings of capability, it is important to keep capability requirements themselves under review. Timely and periodic review and assessment has the potential to identify changing circumstances and keep options open for government.

5.49 In response to the draft audit report, in April 2012 the Chief of Army provided clarifying comments on the use and meaning of the term 'capability gap':

The term refers to the difference between a stated capability requirement and Army's ability to fulfil that requirement ...

While the existing level of protection of the [*upgraded M113*] is high, analysis shows that the vehicle's major limitation will be its ability to support close

²²⁰ The Acting Chief of Army's letter appears in its entirety in Appendix 3 of this Report.

²²¹ Army's Response to ANAO Issues Papers, 19 December 2011.

combat operations against an enemy which is capable of employing a broad variety of conventional and unconventional methods of attack.²²²

5.50 The Chief of Army also noted that:

as the Capability Manager ... I am satisfied that the [*upgraded M113*] provides a significantly enhanced capability to Army and that it is a potent and capable platform. I am also satisfied that the delivery of [*the upgrade project*] satisfies the *original* [emphasis added] requirement specified by the Capability Manager.



Ian McPhee

Auditor-General

Canberra ACT

24 May 2012

²²² The Chief of Army's full response appears in its entirety in Appendix 4 of this report.

Appendices

Appendix 1: The Fundamental Inputs to Capability (FIC) and their relation to M113 capability

Fundamental Input	Description	Relation to M113 capability
Major systems	Those systems that have a unit cost of \$1m or more. Major systems are core components of capability that regularly require more detailed reporting and management.	The APCs and other variants.
Facilities	Buildings, structures, property, plant and equipment, and areas for training and other purposes, as well as utilities and civil engineering support.	Facilities for storage, maintenance and training with the M113s.
Supplies	There are 10 classes of supplies, many of which need more consideration than just quantity (for example serviceability, configuration and operational viability).	Sufficient and appropriate spare parts, fuel, ammunition etc.
Support	A broad category that involves support to all areas of Defence, from communications and IT to research and development to administrative and logistical support. Support services may be provided by external organisations.	All the areas of support that the M113s and their operators may need, such as maintenance, communications and adequate information management systems.
Personnel	Personnel who satisfy the necessary readiness requirements and have the competencies to perform the functions of their positions.	A sufficient number of appropriately prepared soldiers to operate the M113s.
Organisation	The required personnel establishment, correct structure and the appropriate balance of skills.	Appropriately organised and skilled groupings that will be involved with utilising the M113s.
Collective training	A comprehensive and on-going collective training regime validated against preparedness requirements.	A training regime involving M113s that provide soldiers with knowledge of how to operate the M113s and how they are intended to be utilised.
Command & Management	Command and decision-making processes and procedures at all levels of Defence needed to plan, apply, measure, monitor and evaluate agency functions. Command and management include written guidance such as instructions, directions and doctrine.	Operating procedures, guidance on use of M113s and on operating with other ADF elements, maintenance instructions, tactical doctrine etc.

Source: ANAO analysis.

Appendix 2: Recommendations from the previous ANAO audits

Audit Report No.3 2005–06 *Management of the M113 Armoured Personnel Carrier Upgrade Project*

Recommendation No.1: ANAO recommends that the Defence Materiel Organisation put in place control mechanisms to ensure that changes in scope are approved at the appropriate level.

Defence Response: Agreed

Recommendation No.2: ANAO recommends that the Defence Materiel Organisation recover against deliverables, the outstanding amount of the May 1997 mobilisation payment remaining from the Phase 1(a) M113 Upgrade Contract at the earliest opportunity.

Defence Response: Agreed

Recommendation No.3: ANAO recommends that the Defence Materiel Organisation review contracting policy and its application of the collection of liquidated damages, to be received either by way of financial or agreed compensation, to ensure that they are collected in a timely manner.

Defence Response: Agreed

Audit Report No.27 2008–09 *Management of the M113 Armoured Personnel Carrier Upgrade Project*

Recommendation No.1: ANAO recommends that Defence and DMO set suitable threshold criteria for determining changes in scope to acquisition projects and promulgate advice to staff to allow decision-makers to be provided with sufficient, consistent and appropriate information and advice on potential scope changes.

Defence Response: Agreed

Recommendation No.2: ANAO recommends that Defence develop clear policy guidance on the circumstances in which prepayments will be considered for

inclusion in future major acquisition contracts, and maintain an appropriate record of the basis for agreeing to advance payments as part of contract negotiations.

Defence Response: Agreed

Recommendation No.3: ANAO recommends that Defence ensure that liquidated damages arrangements in future major acquisition contracts apply to clearly identified, key contract milestones.

Defence Response: Agreed

Appendix 3: Letter from the Acting Chief of Army Regarding Capability: 19 December 2011



AUSTRALIAN ARMY
(Office of the Chief of Army)

MINUTE

OCA/OUT/2011/R10529216

EXECUTIVE DIRECTOR - ANAO PERFORMANCE AUDIT SERVICES GROUP
(Ms Fran Holbert)

PERFORMANCE AUDIT: M113 UPGRADE PROJECT – LAND 106

1. I am advised that the Performance Audit on Project Land 106 has recently been concluded and that Issues Papers have been forwarded to Defence for consideration. I am aware that my staff are assisting your team with finalising specific capability aspects of the audit as they relate to this project and understand there remains program related issues that are being pursued between ANAO and the DMO to finalise the audit. In the most recent discussions between our respective staff, it was requested that Army provide my assessment as the Capability Manager of the M113AS4 Family of Vehicles (FOV) to be delivered by this project.

2. The first sub-unit level delivery of the M113AS4 FOV occurred in late 2007 and since that time, vehicle numbers and variant types have increased to enable the replacement of the obsolete M113A1 FOV that had been in-service since the 1960s. The M113AS4 FOV includes seven variants and is approved to deliver 431 vehicles. The Armoured Personnel Carrier (APC) variant is the most widely employed variant at 220 vehicles and is the primary platform for conducting mounted close combat. The other variants provide a range of combat and combat service support functions with comparable mobility, protection and communications.

3. The M113AS4 FOV provides a significant enhancement to Army's mounted close combat capability and is now the primary platform of the 1st Brigade. The M113AS4 provides an armoured mobility capability to close with a threat, dismount infantry to conduct close combat and provide supporting direct fires. The capability enhancements afforded by the M113AS4 FOV include mobility, firepower, protection and communications. These four primary vehicle characteristics include the following factors:

- a. **Firepower.** The APC variant provides a powered and armoured turret for the commander, equipped with a Heavy Machine Gun that includes a night capable and magnified sight for accurate long range direct fire.
- b. **Mobility.** The M113AS4 can be transported strategically and operationally in all current air and sea platforms. Most importantly for close combat, the M113AS4 has high cross country mobility and obstacle crossing capabilities that are complementary to the M1A1 Main Battle Tank (MBT).
- c. **Protection.** All variants have a high degree of ballistic protection from small arms fire and artillery fragmentation that is superior to all in-service vehicles except for the MBT. Blast protection is of a lower level in comparison to the ballistic protection level however it can be enhanced by appliqué armour. Other

survivability enhancements tailored to theatre specific threats could be sourced if required, as has been conducted for other in-service vehicles.


- d. **Networked Communications.** All variants are fitted with the vehicle intercom system coupled with secure combat net radio to enable communication both internally and with other vehicles. In the near future, all variants will be fitted with a battle management system which will offer rapid digital information sharing and enhanced situational awareness.

4. The M113AS4 FOV is an APC based platform and is not an Infantry Fighting Vehicle (IFV). The distinction is important as both the APC and IFV have similar characteristics, although the IFV will typically have higher protection and firepower characteristics. This distinction does not however preclude the APC from wide operational employment. In respect to the M113AS4 FOV, the enhancements afforded to all four primary vehicle characteristics enables mechanised force elements to operate with greater flexibility across the full range of contingency operational tasks.

5. It is important to note that while the M113AS4 is a capable combat vehicle, it does have constraints and limitations through design and capacity as it is based on the M113A1 hull. This factor limits its potential in comparison to higher order platforms including current generation IFV. This fact essentially provides a capability gap for the conduct of mounted close combat across the spectrum of conflict until the introduction into service of the Land Combat Vehicle System (LAND 400).

6. The delivery schedule to Army of the M113AS4 FOV and associated support arrangements has recently seen improvement. The DMO advises that 329 of the total 431 vehicles have been completed and that the detailed design of all variants is complete. Additional delay has been experienced in the provision of communications equipment, however this issue is now subject to intensive management by the DMO to improve supply. The revised schedule is planned to deliver all variants by Dec 12, including the provision of communications equipment. This will enable the 1st Brigade to conduct a comprehensive series of collective training objectives within Exercise Hamel in 2012.

6. The M113AS4 FOV is a significant improvement to the obsolete M113A1 FOV and affords greater flexibility in mechanised force structure options for a range of contingency and future tasks until the comprehensive mounted close combat capability that will be provided by LAND 400 solutions.



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19 Dec 11

Appendix 4: Letter from the Chief of Army Regarding Capability: 20 April 2012

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AUSTRALIAN ARMY
(Office of the Chief of Army)

MINUTE

OCA/OUT/2012/R11233320

EXECUTIVE DIRECTOR – ANAO PERFORMANCE AUDIT SERVICES GROUP
(Ms Fran Holbert)

For information:
CEO DMO
CCDG

AUSTRALIAN NATIONAL AUDIT OFFICE PERFORMANCE AUDIT: M113
UPGRADE PROJECT – LAND 106

Reference:

- A. OCA/OUT/2011/R10529216, *Performance Audit: M113 Upgrade Project – Land 106*, dated 19 Dec 11
- B. *The Army Modernisation Handbook*, 2011

1. At Ref A, Army responded to ANAO questions relating to the M113AS4 Upgrade Project, Project LAND 106. The response, provided in my absence by the then acting Chief of Army, MAJGEN Jeff Sengelman, highlighted a range of matters including the significant enhancement the introduction of the M113AS4 represents to Army's close combat capability as well as its constraints and limitations.
2. At a recent meeting involving Defence and ANAO representatives, it was agreed that I would provide clarifying comments with respect to Ref A as the Capability Manager for this Project. It was also agreed that I would comment in response to some linked queries on transportation and capability reporting.
3. The first area I offer clarifying comment on is the use and meaning of the term Capability Gap. A 'capability gap' is a common use term that Army uses as part of its Force Modernisation process as described at Ref B. The term refers to the difference between a stated capability requirement and Army's ability to fulfil that requirement. Army uses a gap analysis methodology to identify the need for future capabilities based on future operating concepts and threats. It is the identification of a capability gap which triggers the need for a replacement system. Based on this process, which informed the Defence White Paper 2009 deliberations, it was determined that the replacement for the M113AS4 will be the Land Combat Vehicle System (LCVS) delivered under Project LAND 400. This process recognised the limitations of the M113AS4, particularly relating to anticipated future threats.

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4. While the existing level of protection of the M113AS4 is high, analysis shows that the vehicle's major limitation will be its ability to support close combat operations against an enemy which is capable of employing a broad variety of conventional and unconventional methods of attack. Specifically, the M113AS4 is vulnerable to Improvised Explosive Devices (IEDs) like those currently being used in the Middle East Area of Operations (MEAO). This vulnerability is also an inherent limitation to many of the world's best Armoured Fighting Vehicles (AFVs). The Australian Light Armoured Vehicle (ASLAV), for example, also has a flat-bottomed hull and it therefore required a Mine Blast Belly Plate (MBBP) to be fitted in order to mitigate current threats in the MEAO. Recognising this, a limited number of Mine Protection Systems (MPS) were procured for the M113AS4, which can be fitted to the platform similar to the use of the MBBP solution for the ASLAV. This MPS significantly enhances the M113AS4's survivability and provides a suitable level of protection against the IED threat.

5. To respond to the questions relating to transportability, a single C17 has the capacity to carry up to four M113AS4s although the full air transportability certification process is still to be completed. A single vehicle can also be transported by a C130 (images at Annex A), although significant preparation of the aircraft is required and significant limitations on aircraft air-land performance would be imposed. It should be noted that the Army's mechanised capability is not a part of the force which is held at very high readiness for short notice contingencies and it would routinely be deployed as a part of the follow on force using sea transport. The RAN's HMAS CHOULES and HMAS TOBRUK can both transport the M113AS4. On land, M113AS4 can be transported by a number of Army's in-service trucks and heavy trailers. Army has sufficient land lift capability to move a single Mechanised Infantry Battalion. LAND 121, Project Overlander has been scoped to deliver vehicles which will also be able to transport the M113AS4.

6. More broadly, I understand through feedback from my staff that ANAO representatives may have received a range of views on the M113AS4 in the conduct of this Audit. It is no surprise that individuals within the Army have articulated various opinions concerning the M113AS4 capability and its suitability for employment - the Army encourages debate and comment about our concepts and capabilities. I welcome this and strongly endorse the importance of wide access for ANAO representatives, however, the provision of formal advice on matters of Army Capability remain my responsibility.

7. To conclude, as the Capability Manager I have confidence in the Army Force Modernisation process. I am satisfied that the M113AS4 provides a significantly enhanced capability to Army and that it is a potent and capable platform. I am also satisfied that the delivery of Project LAND 106 satisfies the original requirement specified by the Capability Manager. I acknowledge that the M113AS4 has vulnerabilities and limitations which are known and which also have been formally reported. At present, this does not represent a capability deficiency when measured against directed requirements and as such there remains no requirement to advise CDG or the Government. I am satisfied that sufficient means to transport these vehicles by land and sea are available to meet directed requirements and acknowledge that the ability to transport the M113AS4 by C17 remains subject to completion of the full air transportability certification process.

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8. Army's submission at Ref A, concerning the M113AS4 should be read in light of the additional clarification provided by this correspondence.



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LTGEN
CA

20 Apr 12

Annex:

A. Photos – M113AS4 Loading on to RAAF C130

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