STRATEGIC INSIGHTS
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Project LAND 400: defining the army

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Spend enough time in a queue for coffee at Defence's Russell Offices and you're sure to hear some Army folk complaining about how the land forces are chronically short-changed for modern equipment compared to the Air Force and Navy. But a glance at Chapter 6 of the 2016 Integrated Investment Program shows that they'll need to find something else to grizzle about.[1]

Defence's most comprehensive, and expensive, package of land force modernisation is underway, at a cost of $50–70 billion.[2] Nine complementary programs cover every area of land warfare, from personal equipment for the soldiers through to unmanned aerial vehicles, amphibious craft, special forces helicopters, digital networks, surface-to-air missiles and long-range battlefield rocket systems. Moreover, those programs are in addition to Navy and Air Force projects, such as sea and air lift, that directly support the land force.

Among these programmatic riches, the jewel in the crown is Project Land 400, through which Defence intends to replace the Army's fleets of armoured cavalry vehicles (ASLAVs) and M113 armoured personnel carriers (APCs). According to Defence, the project will deliver the Army's next generation of armoured fighting vehicles, with the firepower, protection and mobility to defeat increasingly lethal and adaptive adversaries well into the future.

A BAE Systems Australia Patria AMV35 (left) and a Rheinmetall Boxer CRV (right) drive through the armoured fighting vehicle field firing training area at Puckapunyal Range, Victoria, while participating in the Land 400 risk mitigation activity on 22 February 2017 © Images courtesy Australian Department of Defence.

The Phase 1 scoping study has been completed and soon the government will decide the successful contender to replace the ASLAVs under Phase 2, at a cost of $4–5 billion. The first deliveries are planned to occur by 2020, the first Armoured Cavalry Regiment (ACR) is to be re-equipped by 2022, and all three ACRs are planned to be re-equipped by 2026 (although Defence acknowledges that this acquisition schedule is unlikely to be achieved.)

Phase 3 will formally kick off later this year when Defence issues a request for tender to replace the fleet of M113 APCs and acquire armoured engineer vehicles (mobility support vehicles), at a cost of $10–15 billion. Phase 4 will acquire an integrated training system for these platforms at a cost of $400–500 million.

At a program cost of $14–20 billion, Land 400 is the most expensive acquisition project in the Army's history. But beyond the sheer cost, the government's decisions on Land 400 will be the most significant among the whole portfolio of Land projects in setting the direction of the ADF's land forces for a generation to come. So Land 400 warrants the most careful consideration by government, not simply of how well the bids match the specified requirements but also (and more importantly) how well the project fits into the government's grand strategy for structuring and employing land forces in support of Australia's defence and security over the next 30 years and beyond. More than just a vehicle fleet replacement, Land 400 will define the Army for years to come.

To fully understand the implications of Land 400 for the ADF's land forces, it's necessary to go beyond the vehicles' characteristics and take a systems approach. This means considering not just the future battlefield operating environment (to determine whether the vehicles are fit for purpose) but also the broader force structure context into which the project fits, to inform judgements about whether the project as a whole is fit for purpose at the grand strategy and whole-of-ADF level.

A systems perspective is particularly important for land projects because the total capability of a land force is distributed among many different units; the total capability effect is delivered by the components working together in a concerted way to maximise their strengths and minimise their limitations and vulnerabilities. This 'concert' phenomenon lies at the heart of why the 'software' of organisational structure, doctrine/concepts and skills makes such a big difference to the performance of land forces.

These are big issues, and this Strategic Insight is necessarily an abbreviated summary (some further detail is in the appendix).

First, a look at the contenders. There are two shortlisted bidders for Phase 2 combat reconnaissance vehicles (CRVs). As noted above, the Phase 3 infantry fighting vehicle (IFV) is still wide open; Defence is expected to release a request for tender this year.

Phase 2: the contenders

The Phase 2 CRV contenders are the Patria armoured modular vehicle (AMV) from BAE Systems Australia and the Boxer vehicle from Rheinmetall Defence Australia. The AMV has proven to be a popular design, and a total of around 1,900 vehicles in several variants have been exported to eight countries. The Boxer hasn't been in the market for quite as long as the AMV, but more than 700 units have been ordered by Germany, the Netherlands, Lithuania and, most recently, Slovenia.

Both contenders are superficially similar to the ASLAV inasmuch as they're eight-wheeled armoured vehicles, originally designed as infantry carriers but able to take a manned turret equipped with a rapid-fire, high-velocity cannon and still able to carry a few scouts in the hull. These similarities reflect the project operating concept, which essentially seeks a vehicle that can perform the same missions as the ASLAV (reconnaissance, counter-reconnaissance, constraining the enemy's freedom of manoeuvre with firepower) but with more effective sensors and weapons, better battle management networking capability and better protection to cope with more dangerous threats.[3]

However, it's important to note that both contenders are significantly heavier and larger than the ASLAV (Table 1). This allows them to be better protected against mine and improvised explosive device (IED) threats as well as artillery fragments, RPGs and cannon fire. The Phase 1 studies have tested those aspects extensively, including through blast trials. The AMV and Boxer also have improved passive protection systems and have the potential to integrate active defence systems.

Table 1: Land 400 Phase 2 combat reconnaissance vehicles—selected characteristics

Vehicle type	Dimensions: L x W x H track clearance (m)	Engine power weight power:weight ratio	Tactical mobility	Crew + dismounts	Main armament
ASLAV (for comparison)	6.57 × 2.77 × 2.43	205 kW 13.5 t 15.2 kW/t	8 × 8 wheels 100 km/h 600 km range	3 + 6	25 mm
AMV35	8.00 × 2.87 × 3.5 2.45 track 0.43 m ground clearance	450 kW 30 t 15.0 kW/t	8 × 8 wheels 100 km/h 1,000 km range 60% gradient 2 m trench 0.7 m step 4th axle steering 17.5m turn circle	3 + 4	35 mm (70 ready rounds) Rafael Spike or MBDA MMP anti-tank guided missile
Boxer	7.93 × 2.99 × 3.24 2.58 track 0.5 m ground clearance	530 kW 38.5 t 13.7 kW/t	8 × 8 wheels 103 km/h >650 km range 60% gradient 2 m trench 0.8 m step 2 axle & skid steering 18 m turn circle	3 + 4	30 mm (200 ready rounds) Spike anti-tank guided missile
Hawkei (for comparison)	5.78 × 2.4. × 2.3	200 kW 7 t 28.5 kW/t	4 × 4 wheels >100 km/h 600 km range	2 + 3–4	Machine-gun ring or remote weapon station

Source: Department of Defence, LAND 400: Phase 2, online.

The Boxer is appreciably heavier than the AMV (around 38 tonnes versus 30 tonnes), depending on the load configuration. This weight differential is probably due to higher levels of protection (Defence has emphasised protection in its evaluation). Both the Boxer and the AMV have some scope to adjust their protection fit-outs up or down to suit the mission.[4]

However there are trade-offs for this weight. One trade-off is a constrained strategic deployability. For example, while the C-130J transport aircraft can carry one ASLAV, both contenders are too heavy for the aircraft. The ADF's C-17 heavy lift aircraft can carry up to four ASLAVs, but only one Boxer or, at a stretch, two AMV35s. And there are only eight C-17s in the ADF, compared to 12 C-130Js.

In addition, some critics argue that the weight and size of the contenders makes them insufficiently tactically mobile for the reconnaissance role, as they'll be too heavy for the rough terrain, poor-quality roads and limited bridges typically found in Australia's region.[5] A CRV with these limitations on its tactical mobility would indeed be significantly constrained in its role, although, in fairness, those criticisms are disputed.[6]

Another factor in battlefield mobility is that both contenders are wheeled; it's a silent tribute to the success of the ASLAV in service that Defence has sought a wheeled, rather than tracked, replacement CRV. Professional opinion varies on the relative merits of wheeled versus tracked armoured vehicles, reflecting the different trade-offs.[7] Wheeled reconnaissance vehicles are generally quieter and more comfortable for the crew and passengers, mechanically more reliable, and easier to maintain and support, which translates into better strategic/long-range mobility, a lower logistics footprint and lower costs of ownership. Tracked vehicles have

better mobility over extremely rough or slippery ground, and tracks can support a heavier vehicle mass. There are professional arguments both ways as to which is more important for a CRV (for example, the UK is acquiring the tracked Ajax vehicle as its CRV equivalent). There's no universally correct approach, and trade-offs will need to be made. Making trade-offs requires a well-developed understanding of your needs and the value you ascribe to them as a basis for merely understanding the nature of the trade-offs—let alone prioritising them. More on this below.

In terms of situational awareness—the core of a CRV's *raison d'être*—the contenders, compared to the ASLAV, are much better equipped with more sophisticated sensors and electronics, including threat detection and fire control systems. The AMV35 variant proposed for Land 400 has a manned turret with 35-mm cannon (compared to the ASLAV's 25-mm cannon) and an integrated launcher for two guided anti-tank missiles (Rafael Spike or MBDA MMP). The Boxer variant has a manned Lance turret with 30-mm Rheinmetall Mk30 cannon and an integrated launcher for two Spike guided missiles. The effective range of the 35-mm cannon is reported as 4,000 metres,[8] while the range of the 30-mm cannon is 3,000 metres, and the weight of shell of the AMV weapon is up to 50% greater than for the 30-mm weapon; the trade-off (there's always one!) is that fewer of the larger rounds can be carried (70 versus 200). Overall, Defence assesses that, notwithstanding the differences, both weapons systems conform to the Army's lethality requirements to kill or suppress infantry, either in the open or in protected positions, destroy soft and light armoured vehicles, and disable key optics and sensors of tanks (provided the CRV gets first shot).[9]

On balance, both contenders present as more capable, latest generation updates on the ASLAV. Both are inferior to the ASLAV in terms of strategic deployability, and the Boxer is more problematic than the AMV in that respect. On the other hand, the Boxer seems to have the best ballistic protection. Cost-of-ownership figures aren't publicly available, but the Boxer's greater weight means it's likely to be the highest cost solution.

Phase 2 industry packages

Defence projects in recent years have come to strongly emphasise domestic industry, and Land 400 continues that trend. If politics plays a role, then watch Queensland and Victoria, because BAE has offered to establish a defence hub at Fishermans Bend, Melbourne, to build and assemble the AMV, while Rheinmetall has offered to establish a Military Vehicle Centre of Excellence in Brisbane. Both state governments are strong advocates for their respective industrial champions. The Victorian Government has claimed that up to 2,000 manufacturing and supply-chain jobs will be created in Victoria if BAE wins the project. It may be relevant that a state election in Victoria will be held on 24 November 2018. While Queensland's state election was held last November (returning a Labor government), a federal election is due around the middle of 2019, and Queensland is a known vulnerable spot for the Coalition government.

Phase 3 infantry fighting vehicles

Phase 3 involves the acquisition of around 450 IFVs to equip three mechanised infantry battalions in the Army combat brigades. Phase 3 will also acquire 17 mobility support vehicles, which are protected, tracked, specialist engineer vehicles.

For Phase 3, it's expected that Defence will favour IFV designs that combine high levels of protection, mobility commensurate with the M1 tank, situational awareness and networking capability, and similar armament to the CRV. These features reflect the ADF's priority to improve the land force's capability to conduct mechanised operations involving close cooperation between mechanised infantry and tanks.[10]

However, if a wheeled vehicle were accepted for Phase 3, then there would be an opportunity to realise the substantial benefits (cost, industry packages, logistics support and training) of having a common fleet of Land 400 CRVs and IFVs. Both the AMV and the Boxer were originally designed as infantry carriers, and most exports have been APC or IFV variants.[11] Defence should provide government with a cost–benefit analysis of these options when it comes to decide on Phase 3.

Table 2 lists three possible Phase 3 contenders, along with the M113AS4 and the Bushmaster protected mobility vehicle (PMV) for comparison (as noted above, versions of the Boxer and AMV might also fill the IFV role). The CV90/35 and the two Lynx variants are produced by BAE and Rheinmetall, respectively, which are also bidding for Phase 2. The CV90/35 and Lynx 31 and 41 have virtually identical turrets to the bidders' CRVs, so, while Phase 3 is still wide open for other bidders, there are obvious opportunities for commonality by selecting the same company's products for Phases 2 and 3, with consequent benefit for Australian industry packages, more efficient logistic support and reduced training burden.[12]

Table 2: Land 400 Phase 3 infantry fighting vehicles—selected characteristics of some typical exemplars

Vehicle type	Dimensions L × H × W track clearance (m)	Engine power weight power:weight ratio	Tactical mobility	Crew + dismounts	Main armament
M113AS4 (for comparison)	6.0 × 2.69 × 2.61	350 kW 18 t 19 kW/t	Tracked 66 km/h 550 km range 60% gradient 1.9 m trench 0.6 m step	2 + 10	12.7 mm
CV90/35 (data for Mk III)	6.55 × 3.1 × 2.7 0.45 m ground clearance	595 kW 35 t 17 kW/t	Tracked 70 km/h 900 km range	3 + 8	35 mm
Lynx 31	7.22 × 3.6 × 3.3	550 kW 38 t 14.5 kW/t	Tracked 65 km/h (range unknown) 60% gradient 2.5 m trench 1 m step	3 + 6	30 mm Spike ATGM
Lynx 41	7.73 × 3.6 × 3.3	800 kW 45 t 17.8 kW/t	Tracked 70 km/h (range unknown) 60% gradient 2.5 m trench 1 m step	3 + 8	30 mm Spike ATGM
Bushmaster (for comparison)	7.18 × 2.48 × 2.65 1.34–1.95 m ground clearance	224 kW 12.5 t 17.9 kW/t	4x4 115 km/h 600 km range 60% gradient	2 + 8	Machine-gun ring or remote weapon station
M1A1 (for comparison)	9.83 × 3.65 × 2.89 0.48 m ground clearance	1,120 kW 62 18 kW/t	Tracked >60 km/h >400 km range	4	120 mm

A set of comparative tables can only take us so far; it's time to look at the project within the context of the broader land force structure.

The force structure context

Although some might see Land 400 as a simple vehicle fleet replacement project, there are larger implications for the force structure. Several critics have been quick to notice the project's potential to distort the ADF force structure because of the high cost of the project (which they argue would be better invested in maritime capabilities), a misalignment between heavy mechanised armoured units and the strategic priority for highly deployable and logistically sustainable ground forces to deal with crises in our neighbourhood, or both.[13]

Defence's push for a heavier mechanised balance in the land force structure is interesting; in the popular imagination, the Australian Army is characterised above all by tough, skilful infantry rather than armour. Operations by special forces and infantry over decades in Southeast Asia and more recently in East Timor and the Middle East continue that tradition into modern times.

But the Army has long nurtured a vision for a bigger role for armour in its force structure, and this is well expressed in the portfolio of modernisation projects and, specifically, the Land 400 Phase 3 IFV. Antecedents can be found in the 1980s Army structure, which incorporated a notional mechanised brigade, and especially in the concept for a hardened and networked army (HNA), first articulated in 2003 by the then Chief of Army, Lieutenant General Peter Leahy and approved by government in 2005.[14] The HNA concept envisaged the Army growing into a 'medium weight' force, with more infantry units, Bushmaster armoured troop carriers and new M1A1 tanks for support. The land force would be equipped with sensors and communications to network the force to realise the fullest combat potential of the hardware.

HNA became the principled rationalisation for several existing projects, such as the M113AS4 upgrade, and a justification for replacing the Leopard main battle tanks with M1A1 tanks. However, HNA did not propose a predominantly heavy armoured force of the kind found in, say, NATO armies; the desire for new tanks was explicitly linked to supporting the infantry. Although the HNA concept attracted criticism for being costly and too armour-oriented for Australia's strategic needs, the modest number (59) of tanks that were acquired belied that fear (but note that the Army hopes to acquire around 90 upgraded tanks).[15]

Nevertheless, those with long memories could be forgiven for their suspicions about the Army's ambitions. After all, in the 1980s, under Project Waler, the Army sought to replace its Vietnam-era M113 APCs with up to 1,000 IFVs—such as the German Marder—designed for mechanised operations against Soviet forces in Europe. The hardware was to be complemented by the acquisition of a very large manoeuvre training area in prime agricultural land in New South Wales. In the end, the vision proved to be an overreach for its time; the expected financial and political costs didn't seem commensurate with the strategic benefit, and Project Waler was shelved in 1985.

Nowadays, the Army's force modernisation is based on the force structure outlined in Plan Beersheba.[16] Plan Beersheba was born from the Army's struggles to continuously generate forces for operations overseas over the past decade and more. The plan sets out a 36-month force generation cycle in which one of the three combat brigades (the 'ready' brigade) is fully trained and equipped for operations for 12 months, while another is in a 12-month preparation phase to take over from the ready brigade, and the third 'reset' brigade is in a 12-month rest and recovery phase after previously being the ready brigade. This rotational readiness cycle enables the Army to continuously generate a combat brigade for operations over an indefinite period.

While Plan Beersheba is ostensibly about force generation and readiness, it also drives force structure. It has shifted the Army from role-specialised combat brigades to three similarly structured and equipped brigades.[17] A consequence of the similar structure and equipment is the need to triplicate certain assets (such as tanks) that were previously concentrated in one of the brigades. An offsetting benefit of this extra recurring cost is that the ADF is now capable of generating larger, brigade-sized forces for operations over a protracted period of years.

The three combat brigades are structured around an Armoured Cavalry Regiment (with one tank and two ASLAV cavalry squadrons), a mechanised infantry battalion (with M113AS4 tracked APCs), a motorised infantry battalion (with Bushmaster PMVs), an artillery regiment (with 155-mm towed guns), a combat engineer regiment, plus communications, logistics and enablers.

In addition to the combat brigades, the land force comprises:

- a dedicated amphibious infantry battalion (2 Royal Australia Regiment), able to provide a pre-landing force for a combat brigade
- special forces, comprising the SAS Regiment, two Commando battalions, and special operations engineer, logistics and training units
- enabler brigades, providing capabilities in intelligence, surveillance and targeting, communications, engineers, anti-aircraft missiles, medical and aviation (heavy lift, medium utility transport and armed reconnaissance helicopters).

This land force structure provides a portfolio of units and capabilities from which a tailored taskforce can be organised to suit the particular mission or task at hand. There's no unshakeable necessity to deploy a combat brigade as per its peacetime organisation. Given sufficient notice and time to prepare, a combat brigade could reorganise (through the force generation cycle) to emphasise motorised infantry over mechanised infantry, or vice versa.

Some of the criticisms of the Army's trend towards mechanisation may underestimate how task organisation allows the ADF to adapt its deployed taskforces to suit a variety of contingencies, including, for example, stabilisation operations, peacekeeping or disaster relief. Nevertheless, it's a simple fact that after Land 400 is implemented about half the infantry battalions in the combat brigades will be mechanised with much heavier vehicles. Even task organisation must still work with the components at hand. As noted above, there has been criticism that this force structure will be too heavy for Australia's strategic needs, particularly for crises in our neighbourhood.

This matters; neighbourhood crises are more liable than major coalition operations to demand rapid action by the ADF, and it usually falls to Australia to lead a response. Neighbourhood crises are much more likely to impinge on Australia's direct security interests than major coalition operations, particularly outside the Indo-Pacific region. These politico-strategic imperatives imply that neighbourhood contingencies should rate higher than major coalition combat operations in the consideration of trade-offs of project requirements. By this logic, strategic deployability and suitability for limited infrastructure and tropical terrain, together with logistics supportability, should score more highly for Land 400 than appears to be the case.[18] A RAND study sponsored by Defence explores this issue, and highlights that the government and Defence have a starker choice than they may realise between equipment solutions that are optimised for neighbourhood crises versus major coalition contingencies.[19]

It may be useful to compare an ADF combat brigade with a peer organisation—a US Marine Expeditionary Brigade (MEB). The MEB is a joint taskforce optimised for expeditionary missions involving all spectrums of conflict with a maritime/littoral orientation, which parallels the desired characteristics of the ADF land forces.[20] The force structure of the MEB normally comprises:

- 3 infantry battalions
- 1 amphibious APC company (48 AAV-7A1s)
- 1 light armoured vehicle (LAV) company (27 LAVs—similar to ASLAVs)
- 1 M1A1 tank company (14 tanks)
- 1 force reconnaissance company (a similar role to the 2 RAR pre-landing element)
- 1 towed artillery regiment (24 tubes—the same 155-mm gun as the ADF)
- headquarters, intelligence, communications staff
- logistics enabling units.

In addition, an MEB would normally deploy with a Marine Air Group comprising several squadrons of strike fighters and helicopters (heavy, medium/utility and armed reconnaissance), and a US Navy task group would also provide support.

An ADF combat brigade stands close comparison to the MEB, provided the Air Force and Navy come to the party with a similar level of support to that which an MEB would get from the Marine Air Group and naval task group—and, of course, provided that air bases are within range and that Australian surface ships can safely operate in support of the land force. It's notable that, once Land 400 is delivered, an ADF combat brigade will have a much better provision of armour for the infantry components (one battalion in IFVs, one battalion in Bushmasters, plus Hawkei). Adding to this gap, the MEB has only one company of LAVs (compared to two CRV companies in an ADF combat brigade), and the US Marine Corps has only just started to think about replacing its (upgraded) LAVs with a powerful (but heavy) CRV-equivalent. On the other hand, the MEB has an extra infantry battalion compared to an ADF combat brigade; maybe this extra battalion gives the MEB a better balanced force structure, especially for neighbourhood crises and stabilisation operations.

One important factor behind the MEB's relative lightness in heavier armoured vehicles is that it's harder to deploy and sustain a heavy armoured force (and note that the Marine Corps has a much larger amphibious fleet to draw on than the ADF, notwithstanding the high profile of the RAN's LHDs). In this context, it's worth noting that the Marine Corps is evaluating eight-wheeled, amphibious-swimming armoured vehicles (but not the AMV or Boxer) to replace its tracked amphibious APCs[21]; the Marines consider that those vehicles have sufficient mobility to accompany their M1A1 tanks, are more supportable, and have good amphibious-swimming performance (which isn't a Land 400 requirement). The ADF was able to airlift ASLAVs and M113 vehicles very rapidly to East Timor as part of INTERFET, but such an operational deployment would be far more difficult with Land 400's non-swimming, +30-tonne vehicles.

Defence counters these criticisms of its evolution to a heavier land force structure by pointing to the character of the future operating environment, which, it argues, will involve more complex and lethal battlefields that render ASLAVs and M113s—or similar 'light' armour—unfit for purpose.

The character of the future operating environment

Defence judges that the contemporary and future threat environment requires its CRVs and IFVs to be more survivable, with better sensors, weapons systems and information systems able to network to strategic intelligence platforms.[22]

In coming to this view, Defence has drawn on lessons of operations in Afghanistan, Iraq, Lebanon, and Ukraine over the past 15 years.[23] Defence believes that those lessons are generic and relevant to Australia's strategic circumstances.

One lesson is that weapons technology is ever more lethal and precise, and is or could be widely proliferated, even to non-state groups. The threat of IEDs has assumed a high priority and is now a strong influence on weapons systems designs from electronic warfare (EW) and countermeasures to armoured vehicles. Non-state groups in Iraq and Lebanon have shown that they can effectively employ modern anti-aircraft and anti-armour guided weapons and have destroyed the best tanks of Israel and the US. Hezbollah has developed the sophistication to employ coastal anti-ship missiles against Israeli Navy ships. The hybrid separatist conflict in Ukraine has also shown the lethal effectiveness of long-range precision fire from artillery and rockets.

Another lesson is that operational environments are complex and multidimensional in terms of urban terrain, human geography and the potential for rapid changes in the level of threat. The expansion of urban terrain is a corollary of urbanisation and population growth, and adversaries have deliberately operated among civilians. Complex terrain makes it difficult for modern armies to exploit their traditional advantages in sensors, networks, skills and firepower.

Non-state militias and armies, such as Hezbollah in Lebanon and the Taliban in Afghanistan, have shown adaptability and tactical skill. In Ukraine, the Russian-sponsored separatist conflict has involved a complex mixture of unskilled militias backed up by highly skilled professional soldiers and very advanced EW, anti-armour weapons and long-range precision artillery and rockets. The Ukrainian conflict has shown that even insurgencies (at least, state-sponsored ones) can, at times, involve a high level of threat and result in heavy casualties, including to armoured units.

In short, Defence believes that modern land forces must work on the assumption that any adversary could demonstrate (or be able to get access to) tactical skills, advanced weapons and advanced fire support and enabling capabilities, such as cyber and EW technologies.

Finally, one of the most profound lessons is an extreme sensitivity to personnel deaths and injury, particularly among our own and friendly forces and civilians but also (depending on the circumstances) among adversaries. Force protection (in the jargon) has become one of the highest priorities, and this has undoubtedly influenced ADF force structure planning and Land 400 specifically. It should be remembered that, besides obvious safety considerations, force protection is also beneficial for mission success because it helps assure that the task will be completed in the face of hostile action, and that restraint can be safely exercised in the use of lethal weapons to achieve the task, which is particularly important in peacekeeping-type operations. Defence's Land 400 submissions to government will feature force protection issues prominently.

These trends come together in Defence's push to replace the ASLAVs and M113s with vehicles that are better protected and armed and have better sensors and networks for situational awareness. Defence has produced a helpful storyboard to explain its approach to close combat.[24] In essence, it argues for highly capable reconnaissance assets and mechanised infantry operating with tanks to identify adversary forces, counter the adversary's reconnaissance units, and move quickly through the lethal fire zone of the battlefield to assault the adversary's positions and destroy or defeat them. This requires excellent protection from the adversary's weapons and artillery, good sensors and networks, good mobility (in the case of mechanised infantry, able to keep up with tanks), and firepower to suppress and destroy adversary armour and infantry in protected positions.[25] In contrast, motorised infantry can't safely enter the direct fire zone in their Bushmasters, so instead they debark their vehicles in a safe area and proceed, slowly and carefully, through the defended fire zone, with fire support and by classic fire and movement, to clear the enemy position.

This storyboard view is compelling (especially for those in the first wave) but it's only one view of one type of battlefield. A systems approach, at the level of the mission and campaign, allows for a prudent and ethical trade-off of risks in the fire zone versus risks to the mission and campaign. For example, more lightly armoured forces (which might still have some heavy components), while more vulnerable to some forms of attack, could offset their apparent disadvantages by drawing on external fire support or manoeuvre. And lighter forces could achieve superior campaign outcomes through being capable of more rapid deployment of forces to key points, and through a smaller logistics footprint that's less vulnerable and easier to sustain (for example, the US Army expects to refuel M1 tanks twice per day on operations—that's over 3,700 litres per tank per day).

To be clear, there are few absolutely right or wrong solutions to this wicked set of problems; optimisation is the more useful concept. However, applying the nuanced consideration that's at the heart of optimisation depends on a deep understanding of what the higher level objective is so that lower level trade-offs can be made. Unfortunately, the strategic guidance for designing the ADF force structure is distinctly unhelpful when it comes to applying nuance.

The guidance gap

The *2016 Defence White Paper* (paragraph 3.11, page 71) lists three high-level 'strategic defence objectives':

- Deter, deny and defeat attacks on, or threats to, Australia and its national interests, and northern approaches.
- Make effective military contributions to support the security of maritime Southeast Asia and Papua New Guinea, Timor Leste and the Pacific island countries.
- Contribute military capabilities to coalitions that support Australia's interests in a rules-based global order.

The three strategic defence objectives have equal weight for designing force structure. This avoidance of setting priorities prevents Defence or the government making informed choices on trade-offs, although such choices are intrinsic to complex decisions on capability and force structure. Interestingly, previous Defence White Papers did not shy away from setting force design priorities.

Some might say that the 'everything is important' approach is a necessary result of a complex, interconnected world—as if a conflict in Central Asia or Africa (or even the Korean peninsula) is as worrying as chaos in a neighbouring state or an attack on Cocos/Keeling Islands or Darwin. Even if flashpoints in the wider world demand attention, contributions to coalitions don't need to deliver a decisive effect to the campaign, whereas the defence of Australia or stabilisation operations in our neighbourhood

do need to result in a favourable outcome. This suggests that, for force design, coalition contributions are less vital and so should carry less weight than neighbourhood or national defence. As an illustration of what can be done, Australia's overseas aid budget is also organised in the context of a sophisticated blend of national interests in an international context, yet it still manages to prioritise our region. Government should be able to apply the same sophisticated sense of priorities to force structure guidance.

Conclusion

The ADF is on the verge of a remarkable, and unprecedented, recapitalisation of the land force. Government decisions on Land 400 will largely define the land force for a generation to come.

Defence's approach to Land 400 is certainly ambitious. Armoured vehicles have come a long way in technology and capability in just the 25 years or so since the ASLAV entered service in the ADF. The Defence organisation has a much better understanding today of how complex and lethal modern battlefields can be. Given this evolving challenge, it's reasonable for the Army to seek CRVs that are more capable and, therefore, more sophisticated and expensive. Land 400 Phase 2 is on track to make a major contribution to the transformation of the land force into a much more technologically sophisticated and more capable force.

But there are potential pitfalls and risks of unbalancing the land force with the Phase 3 emphasis on heavy mechanisation. The US's Marine Expeditionary Brigade provides a peer exemplar of a force that deliberately eschews a heavy mechanised force structure in favour of the benefits of deployability and logistical sustainability. Those benefits aren't merely matters of administrative convenience; they can easily influence mission success or failure, particularly in the logistically challenging environment of our neighbourhood. The US Marines' case also points to the viability of a wheeled armoured IFV, which would allow a common baseline CRV and IFV wheeled fleet; this should be considered by Defence and the government.

The issues of the appropriate force structure balance and the technical suitability of the vehicles are complex, and answers are rarely cut and dried—trade-offs and optimisation must be the approach. To that end, the government's strategic guidance, informed by Defence expertise, could do a lot more than it does now to help distinguish the vital force design objectives from the merely important ones.

Appendix: Land 400 Phase 3 infantry fighting vehicles

Wheels versus tracks

In the wheels versus tracks mobility contest, there's a widely held assumption that, for the IFVs, Defence will favour a tracked vehicle that can accompany tanks over very rough or slippery ground. However it's worth noting that heavy wheeled vehicle technologies are improving a lot, courtesy of civil industry. Currently, the breakpoint in the balance of advantage for tracks over wheels appears to be a vehicle weight over 35 tonnes, or an essential requirement to be able to manoeuvre over very rough or slippery ground. Whether those are important requirements for the IFV depends on how Defence (but, ultimately, the government) needs to operate the vehicles, particularly whether they need to accompany tanks over very rough or slippery ground.
The RAND study commissioned by Defence for Land 400 (*Assessing tracked and wheeled vehicles for Australian mounted close combat operations*, RAND Corporation, 2017) provides a very comprehensive and balanced treatment of these issues.

The essential article: infantry dismounts

Surprisingly, Defence hasn't specified what ought to be a core characteristic of the IFV—the number of infantry to be carried—even though dismounted infantry are the main effector of the IFV, along with the vehicle's sensors and cannon. The issue of optimal section size is a perennial argument and has been the subject of many studies.[26] Most armies consider that a section of around 9–11 soldiers is the optimal number to constitute two or more small fire teams (each organised around a light machine gun) for overwatch manoeuvring, with sufficient firepower to suppress or destroy opposing forces and resilience in case of casualties.

Curiously, despite the consistent findings of these studies, most modern IFVs, such as the Marder, Bradley and Warrior, typically carry only 6–7 dismounts (which is fewer than earlier APCs, such as the M113, which was designed to carry two crew plus 11 dismounts). The explanation for this discrepancy between what armies say is the optimal section size and the record of acquiring IFVs with fewer dismounts is that they're trading off section size for a better protected vehicle, with more powerful sensors and armament (perforce in a larger turret), at an acceptable size/weight and cost.

Defence's perspective on where ADF vehicles belong on the battlefield

Land 121 protected logistic vehicles have a low level of blast and kinetic protection.[27] They're designed to be used in the indirect fire zone, transporting and delivering a range of logistic packages along known routes. They operate away from the threat of direct fire weapons, have enough protection to survive a blast from a mine or IED and can survive an ambush with assault rifles. They complement the Hawkei vehicles, which have similar levels of protection. Hawkei vehicles can be equipped with a suite of C2 systems that allow them to act as a command and control nodes.

Bushmaster PMVs have a higher level of protection and are designed to operate on the edge of the indirect and direct fire zones, delivering fighting troops into battle. They aren't designed to deliberately enter the close combat zone. Although they can withstand hits from machine-guns and sniper rifles, they can't absorb a large weight of fire. They have enough protection to survive these hits, but not to continue fighting. They would have to withdraw to refit.

The CRV is a mid-weight utility vehicle. It has armour to operate throughout the battlefield and is better protected from blast and kinetic weapons. It can freely enter the close combat zone but lacks the weight of protection to remain decisively engaged with the enemy in a high-volume engagement. It's designed to probe the enemy and fight for information without getting decisively committed to a prolonged fight.

The IFV is designed to deliberately enter the close combat zone, withstand high volumes of fire and remain decisively committed for long periods of time. It can take repeated hits from enemy machine-guns and cannon and continue to fight. It fights as a part of the sustained close combat system—IFV, infantry, engineers and main battle tanks supported by offensive support.

The main battle tank is the heavyweight fighter. It has armour to defeat enemy main battle tank fire and can absorb sustained volumes of cannon and machine-gun fire for prolonged periods. It provides intimate support to the dismounted fight and can destroy enemy vehicles and fortifications with precision fire. It's the pre-eminent ground combatant.

Notes

1 Department of Defence (DoD), *2016 Integrated Investment Program*, Australian Government, Canberra, 2016, online.

2 DoD, *2016 Integrated Investment Program*, Table 8.

3 DoD, *LAND 400 land combat vehicle system: concept of operations*, Australian Government, Canberra, 1 December 2011, online.

4 *Defence Technology Review*, December 2017 – January 2018.

5 Nicholas Stuart, 'Land 400 combat reconnaissance vehicles: another disastrously wasteful defence purchase?', *Sydney Morning Herald*, 27 September 2017, online.

6 Mark Abernethy, 'New combat reconnaissance vehicles to be world's most modern', *Australian Financial Review*, 21 June 2017, online.

7 John Matsumura, John Gordon IV, Randall Steeb, Scott Boston, Caitlin Lee, Phillip Padilla, John A Parmentola, *Assessing tracked and wheeled vehicles for Australian mounted close combat operations: lessons learned in recent conflicts, impact of advanced technologies, and system-level implications*, research report RR-1834-AUS, RAND Corporation, Santa Monica, 2017, online.

8 *Defence Technology Review*, December 2017 – January 2018.

9 For a critique of the concept of a heavily armed CRV, see Jim Storr, 'Manned, armoured reconnaissance: why and how?', *Military Operations*, Spring 2014, 2(3):17–19.

10 DoD, *LAND 400 land combat vehicle system: concept of operations*.

11 Defence defines the IFV as a tracked, armoured vehicle armed with an automatic, high-velocity cannon in a manned or unmanned turret. This Strategic Insight adopts another widely used definition in which the key distinction between an APC and an IFV is simply that the IFV is an armoured vehicle armed with an automatic cannon in a turret. IFVs first emerged in the Soviet Union and West Germany in the late 1960s to carry assault infantry in relative safety through no man's land right onto enemy positions.

12 Note that the Netherlands has seen fit to forgo commonality benefits and operates both Rheinmetall's Boxer and BAE's CV90/35.

13 Hugh White, 'Bigger doesn't mean better with combat vehicles', *The Australian*, 30 May 2014, online; Karl Claxton, 'Armour, Army and Australia's future strategy', *The Strategist*, 17 March 2015, online.

14 DoD, *The Hardened and Networked Army*, 2005, online.

15 Mark Abernethy, 'Army's plans for more and better tanks', *Australian Financial Review*, 7 March 2017, online.

16 Australian Army, *Force structure*, 15 June 2017, online.

17 Before Plan Beersheba, the combat brigades were organised primarily around maintaining a set of core skills in various types of land warfare (mechanised, light infantry); the light infantry brigade was also required to provide one light infantry battalion as a ready force for rapid deployment.

18 See Solomon Birch, 'LAND 400: it's about the enablers', *The Strategist*, 27 March 2015, online; Lieutenant Colonel DJ Beaumont, *Transforming Australian Army Logistics to sustain the Joint Land Force*, Future of the Army Series 001, Australian Army, October 2017, online.

19 Matsumura et al., *Assessing tracked and wheeled vehicles for Australian mounted close combat operations*.

20 The US Marine Corps is famous for its specialised amphibious assault capabilities and culture but it also has credible aspirations and capabilities to conduct protracted land campaigns, as shown in Korea, Vietnam, Afghanistan and the first and second wars in Iraq.

21 The US Marine Corps Amphibious Combat Vehicle (ACV) program seeks an eight-wheeled armoured amphibious vehicle to replace its Vietnam-era amphibious assault vehicles. The ACV program seeks a modified, non-developmental vehicle, after several failed attempts to replace the amphibious assault vehicles with a bleeding-edge expeditionary fighting vehicle with a high swimming speed. For the first ACV increment 1.1, equal priority is given to swimming capability, land operations, carrying capacity and force protection (though the program scores extra credit for swimming capability).

22 DoD, *Land combat vehicle system*, Australian Government, no date, online.

23 Directorate of Future Land Warfare, *Future land warfare report 2014*, Australian Army, 2014, online; *Coming to terms with the modern way of war: precision missiles and the land component of Australia's joint force*, Australian Land Warfare Concept series, volume 1, Australian Army, August 2016, online.

24 DoD, *LAND 400 close combat storyboard*, 9 May 2013, online.

25 For a critique of the concept of the IFV, see William Owen, 'Wrong technology for the wrong tactics: the infantry fighting vehicle', *Military Operations*, Winter 2012, 1(3):17–20.

26 See, for example, Leon Engelbrecht, 'The 21st century infantry section: what road to take?', *defenceWeb*, 19 April 2012, online; Bruce Held, Mark A Lorell, James T Quinlivan, Chad C Serena, *Understanding why a ground combat vehicle that carries nine dismounts is important to the Army*, RAND Corporation, Santa Monica, 2013, online; 'Infantry: nine is the magic number', *StrategyPage*, 18 July 2013, online.

27 Thanks to Colonel A Duus, Director Armoured Vehicle Programs, for this section.

Acronyms and abbreviations

ACR	Armoured Cavalry Regiment
ADF	Australian Defence Force
AMV	armoured modular vehicle
APC	armoured personnel carrier
ASLAV	Australian light armoured vehicle
CRV	combat reconnaissance vehicle
EW	electronic warfare
HNA	hardened and networked army
IFV	infantry fighting vehicle
LAV	light armoured vehicle
LHD	landing helicopter dock
MEB	Marine Expeditionary Brigade
PMV	protected mobility vehicle
RAN	Royal Australian Navy

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Important disclaimer

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ISSN 1449-3993