The Future Land Warfare Report 2013

Prepared by:
MODERNISATION AND STRATEGIC PLANNING DIVISION – ARMY
AUSTRALIAN ARMY HEADQUARTERS

Canberra
May 2013

The Directorate of Army Research and Analysis leads work that defines the Army of the future. It does this through the production of concepts that underpin Army's concept-led and capability-based approach to modernisation.

Comment on this publication is welcome and should be forwarded in writing to:

Directorate of Army Research and Analysis
Army Headquarters
Russell Defence Offices
PO Box 7901
CANBERRA BC ACT 2610

Telephone: +61 2 6265 1451
Facsimile: +61 2 6265 4386

INTRODUCTION

1. Since the end of the Cold War, the nature of military interventions and operations has become inherently unpredictable, making it difficult to define the character of future warfare. Interventions in East Timor, Solomon Islands, Bougainville and the wars in Iraq and Afghanistan have placed heavy demands on Army — both anticipated and otherwise — and posed new questions concerning future employment, equipment and doctrine. While today's changing global environment continues to challenge our common assumptions, accelerating technologies in which information and precision dominate also make it increasingly difficult for Army to marry this technology with its core tasks in what is an increasingly cost-conscious Australian Defence Force.

2. Against this backdrop, this examination of future warfare and its implications for the Australian Army is both timely and pertinent. Such an examination, however, necessarily avoids any attempt to predict the future. Given the almost infinite variability of human interaction, such prediction is unlikely to be helpful in designing forces for future conflict. However, there are certain trends and drivers which can be discerned even in such a dynamic environment. Understanding these will provide Army the insight to shape the evolution of the land force capability to ensure it can provide the broadest range of options for government in an evolving security environment.

3. This Future Land Warfare Report describes apparent trends in the future operating environment and suggests their possible influence — individually or in combination — on Army's future land force. This is useful for several reasons. First, and most obviously, understanding these trends allows Army to design its modernisation initiatives and resource those areas of personnel development, material enhancement and joint and interagency connectivity that provide the broadest range of options for government. This is a start point that will drive Army's responses across a variety of modernisation strategies.

4. Second, the report provides a sound basis for Army's contribution to the development of joint capability and to interagency cooperation. Army's national security role demands the ability to operate within a joint force as well as alongside a range of potential partners both within government and from external agencies.

5. Finally, the Future Land Warfare Report equips Army to provide well-informed contributions to policy and strategy development within Australia's emerging national security planning architecture. In the face of increasing government rationalisation across a number of departments, it is Army's responsibility to explain why maintaining its current strength and modernisation plan is vital to the security of the nation. It is imperative that government understand the disadvantages inherent in the current trend of fiscal cuts followed by expansion which is, ultimately, far more expensive than simply sustaining the existing force structure.

6. As this report illustrates, both the emerging regional and global outlook and the changing character of war clearly suggest that land forces will continue to play the decisive role in the security of modern states against both regular and irregular adversaries.

Conflict in the 21st century

7. **The enduring nature of war.** While the character of conflict continues to evolve, its enduring nature remains unchanged. War is and will remain a fundamentally human, societal activity, rather than a technical or engineering problem. It is and will remain a contest of wills in which rational actors seek to mitigate weakness and vulnerability while attempting to exploit either

an opportunity or weakness. Human conflict will continue to be violent, dynamic, unpredictable, difficult to control and chaotic. Chaos will result from the complex interaction of friction, lethality, uncertainty and chance. Surprise and uncertainty will remain an enduring part of conflict.

8. **The changing character of war.** Despite the enduring nature of war, its essential character continues to evolve. Contemporary trends suggest future conflict will increasingly involve multiple diverse actors and influencers, all competing for the allegiances and/or acquiescence of targeted populations. As a consequence, the outcome of conflict will be influenced by the perceptions of these populations rather than solely the results of battlefield action. Advances in technology will continue and the pace of innovation will increase, providing opportunities for our own forces and for adversaries.

9. Against this backdrop, the United States will continue to be the world's strongest military power and the most influential strategic actor in our region. However China's economic transformation is also affecting the regional strategic balance, particularly in the Indo-Pacific. This will inevitably affect the strategic calculations and posture of regional countries. China's burgeoning influence will also affect decision-making on Australia's broader national engagement and approach to military strategy for the foreseeable future.[1]

10. Australia's future prosperity will continue to be tied to the security and stability of our region. Changing patterns of underlying political and economic influence have given rise to new and dynamic strategic relationships. This reflects the long-term trend since the end of the Second World War and Cold War. The rise and re-emergence of nation-states as well as the proliferation of non-state actors are redefining the nature and character of international society, a situation which directly affects Australia's sovereignty as well as its regional and global interests.

11. In any discussion of future war, it is important to understand the context of future conflict and the predominant themes which will define the nature of such conflict. Australia's recent operational experiences and those of other militaries have identified a number of technological and conceptual themes that will define the operational art out to 2035. These are:

a. Success will become increasingly dependent on Army's ability to contribute to the achievement of joint effects, drawn from all elements of national power, in a truly joint and integrated way.

b. Decision superiority, through the provision of those support tools that generate rapid information exchanges in order to support near-instant decision speed, is a critical enabler.

c. The application of rapid overmatching power at decisive points — whether kinetic or non-kinetic in their composition — is likewise crucial.

12. This report does not seek to predict the nature of the future operating environment. However, it acknowledges that it is possible to anticipate 'meta-trends' and discontinuities that will affect the character of future land warfare.[2] These meta-trends will define and influence the operating environment both now and into the future beyond 2035. These trends will be inter-linked, with activities in one influencing the others. The meta-trends that define these conditions are described in a series of groups, namely: crowded,[3] connected,[4] lethal,[5] collective,[6] and constrained.[7] Understanding these trends is essential to any discussion of the nature of future warfare.

META-TRENDS OF THE FUTURE OPERATING ENVIRONMENT

A crowded environment

13. The world's population is expected to reach eight billion by 2030, with the overwhelming majority of this increase (95 per cent) concentrated in the developing world.[8] Furthermore, for the first time in history the world has become more urban than rural.[9] In 1800, only three per cent of the world's population lived in cities. This figure rose to 47 per cent by the end of the 20th century. Today, more people live in cities than rural environments. By 2030, the current urban population of 3.6 billion will rise to five billion, and 60 per cent of people will live in cities.[10]

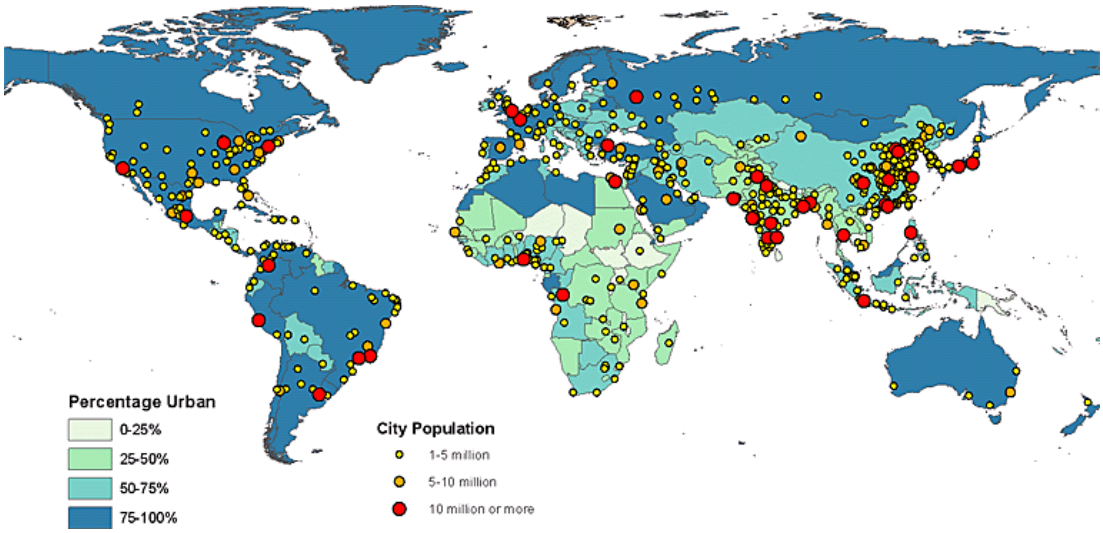

Figure 1: Percentage of urban population and concentrations by size, 2025[11]

14. Figure 1 illustrates the projected increase in urban populations and the growth of 'megacities' by 2025. Over 20 megacities exist today, with six of these cities home to over 20 million inhabitants.[12] By 2025, Asia alone will have at least ten megacities, including Mumbai (33 million), Shanghai (27 million), Karachi (26.5 million), Lahore (12.5 million), Dhaka (26 million), Manila (14.8 million) and Jakarta (25 million).[13] Urbanisation will largely represent the continuation of an existing trend. Massive migration to cities, both internal and transnational, will precipitate an increase in growth in urban populations and spatial concentrations previously unseen in history. Many, living in slums on the fringes of the urban margin, will have limited access to education, health care or the urban economy. These settlements will have insufficient housing and inadequate sanitation and will often be beyond the influence of national law and order authorities.[14]

15. This shift towards urbanisation is likely to produce a decrease in regulation in many heavily populated centres with governments unable to adequately satisfy even the most basic demands. While urbanisation in itself does not represent a destabilising trend, the emergence of unregulated cities (whether large or small) with poor social services provides a haven for organised crime, terrorists and insurgents, offering new bases from which they can organise and launch operations.[15]

16. The majority of this urbanisation will occur in regions that border the ocean. Among the 63 most populated urban areas (with five million or more inhabitants in 2011), 72 per cent are located on or near the coast, with two-thirds in Asia.[16] In the Pacific region, almost all significant concentrations are located adjacent to the coast.

17. Expanding urbanisation will diminish population access to forested areas and wetlands. Rapidly growing cities are likely to compete for supplies of fresh water. Many countries may require international assistance to avert critical food and water shortages. Food security has been aggravated by abnormal weather conditions in the world's land masses over the past two decades. Flows in the Nile, Tigris-Euphrates, Niger, Amazon and Mekong river basins have been diminished by a decade of drought, consistent with the expected effects of warming from increased greenhouse gas concentrations in the atmosphere. Based on current trajectories, the Organisation for Economic Cooperation and Development estimates that, by 2030, almost half the world's population will live in areas suffering severe water stress. Competition for increasingly critical resources is likely to lead to both interstate and intrastate conflict.

18. Scientific observations also reveal that the Arctic ice-shelf is shrinking faster than expected and could vanish sooner than originally predicted in 2030–2050. Even modest sea level rises, when coupled with intense storm surges and the subsidence of delta lands, will have a devastating impact on coastal regions and Pacific small island states. People movement alone will present Australia and the international community, as a collective, with a number of economic and security challenges.[17] These include the economic costs associated with the regulated and secure migration of entire populations to safe ground, the loss of sovereign territory and resources, and the potential for cultural isolation and subsequent unrest both pre and post-migration. Relations between influential powers in the region may deteriorate as states vie for (or resist) migration and mass people movement.

19. **Implications of a crowded environment.** For the land force, operating in urban terrain will no longer be a discretionary activity as this is likely to be the environment in which almost all future military operations occur. These urban operations are also most likely to be conducted in a littoral environment. This will drive the requirement for the land force to deploy to and manoeuvre in and through the littoral. Our nascent amphibious capacity will become a more central element of land force manoeuvre. The development of the conceptual and physical means to undertake this form of manoeuvre — including joint operating concepts, organisations, equipment and support —must be a central element of modernisation initiatives.

20. The urban environment will absorb larger numbers of ground troops than operations in any other type of terrain. Adversaries will attempt to shelter below the discrimination threshold in this congested environment which may result in spikes of violence and generate operational uncertainty. As a result, land forces which have traditionally focused on warfighting, at least early in a campaign, may be required to assume a range of additional responsibilities.

21. As intelligence, surveillance and reconnaissance technologies continue to improve, adversaries will increasingly seek to shelter in complex and congested physical, human and informational terrain.[18] While modern intelligence, surveillance and reconnaissance capabilities allow the ready detection of a potential threat, the land force needs to be capable of discriminating between adversary combatants and the multitude of other actors who are likely to be present within the battlespace. The balance of human versus technical collection capabilities, the types of detection systems (night, heat, emissions), and whether these capabilities are embedded or centralised, manned or unmanned are important issues for ongoing consideration. The need and capacity for the land force to link with and exploit situational awareness from other partners, military and civilian, as well as sources outside the battlespace must be reviewed.

22. Despite the promise of new detection technologies, acceptance of uncertainty and surprise in this urban environment must be an enduring assumption for land forces. In many circumstances, forces will be deployed in situations in which adversary weapon ranges are greater than our

detection capabilities. Resilience and the ability to withstand surprise must be force design considerations in any analysis of the future urban environment. Individual and vehicle protection systems (passive and active) will need to prevail against an unexpected first strike by the adversary. Likewise, adversary detection systems must be compromised and defeated through the employment of active and passive cross-spectrum signature management technologies.

23. In the next decade, the complex urban environment will place demands on the land force that are markedly different to those of the more open forms of warfare of the past decade. Notwithstanding the ongoing refinements to Army's structure, our doctrine and operating concepts, equipment, training and education will require further scrutiny to ensure that Army is suitably prepared for urban operations in the Indo-Pacific littoral.

24. More broadly, crowded characteristics will be evident across land, sea, air, space and cyber domains. The maritime environment will be characterised by large numbers of vessels, busy shipping lanes and choke-points. Airspace will also be filled with friendly, hostile and non-aligned (media) airspace users, including unmanned aircraft. Space-based assets and the greater commercial use of satellites will serve to make orbital space increasingly crowded.[19] The electromagnetic and information environments will also become congested. All these domains will become increasingly interconnected[20] and contested.[21] The proliferation of capabilities that deny, corrupt or intercept satellite-enabled digital communications should be anticipated.

25. Beyond 2025, new technologies and emerging operational approaches will offer some innovative force design options. These should be developed and tested against defined Defence outputs to ensure prudent procurement and investment in an age of austerity. Army force development will need to devise flexible structures and approaches that can generate mass and resilience in the land environment. Linkages to new and evolved defence capabilities that enhance land force situational awareness will be critical to operations beyond 2025. Improvements to airborne early warning aircraft (due from 2027[22]), enhanced tactical unmanned aircraft (from 2025[23]) and improved geospatial support (from 2023[24]) are some of the joint capabilities that will enhance the conduct of land operations — if the right linkages are in place.

A connected environment

26. The term 'connected' refers to the propensity of global economic, social and communications systems to become increasingly interconnected within the future operating environment. Connectivity will continue to be facilitated by global telecommunications networks and ubiquitous communications technology enabling near-instantaneous communications around the globe irrespective of international borders. At the operational level, the five domains of land, sea, air, cyber and space will also become further intertwined and will be the subject of constant competition with land force operations enabled by increasing levels of digitisation.[25]

27. No one country will have complete control over the communications infrastructure and therefore control over the information to which its citizens have access. While undersea cables will still provide most global information and communications technology connectivity, there will be an increasing dependence on space-based assets.[26] All communications nodes will thus continue to offer opportunities for both exploitation and disruption and require increasing levels of protection.

28. Global telecommunications networks coupled with omnipresent communications technology will continue to empower non-state and semi-state actors. The effect will be disproportionate to their size and stature and allow the formation of supra-national organisations within the cyber domain and the potential for 'cyber Balkanisation'. Large populations are also likely to be permanently

connected to global networks, providing ubiquitous access to new 'real time' information. This, combined with burgeoning biometric capabilities, may have a significant effect on the manner in which detection, identification and targeting are conducted and play a critical role in information assurance.

29. **Implications of a connected environment.** Over the next decade, the land force will potentially contribute to securing national interests that rest on an increasingly connected environment through the support of military links between nations or rapid response to a security deterioration or crisis. Land force digitisation will enhance its ability to cope with the demands of this environment. It will improve coordination between land, joint and coalition effects and enable future conflict to be fought across the five operational domains. However, as technological advances enable greater volumes of information to be fused and distributed to more users at lower levels, Army must undertake micro-reforms to improve its information management, handling, exploitation and assurance processes. An analysis of the computational and bandwidth requirements of future command, control, communication and computer systems across the warfighting functions will be a necessary first step to realise opportunities delivered through enhanced military networking.

30. A fully digitised force will be dependent on access to the space domain. Key sub-systems of the networked total force, including battlefield management, communications and global positioning, are currently reliant on space-based platforms. The nature of this dependence, its inherent vulnerabilities, and those viable means of mitigating risk, warrant further exploration, as does the land force's ability to exploit similar vulnerabilities in adversary systems.

31. The ability of land forces to communicate and share information and awareness in the connected environment in which future wars are likely to be fought also warrants assessment. This includes conceptualising the manner in which the land force will collect, fuse, disseminate and store information in a coalition, joint and interagency framework. This concept then requires modelling and testing (to destruction) through simulation and joint and combined exercises to detect stove pipes, choke points and weak points an adversary will attack. An important first step is a review of the capacity of the current land force to connect with other partners and sources from outside the battlespace.

32. Increased levels of digitisation within the land force, coupled with advances in technology, will present significant opportunities for determining the manner in which the land force is supported over the next decade. The use of increased levels of automation within first, second and third line logistic support and the potential use of three-dimensional printing as a viable adjunct to land force logistic chains are areas worthy of further investigation. The employment of medical technologies (such as remote consulting and tele-medicine) by the land force also warrants scrutiny.

33. Networks, such as logistics, will connect nodes by links, and modes of resupply routes, sea and air lines of communication, and computer networks. Innovative logistic support capabilities, such as additive (or three-dimensional) printing, can be exploited in this connected environment. These offer the potential for lighter logistic footprints and more agile logistic support to a deployed force. This will, however, demand a reassessment of technical regulation and logistic policy.

34. The other side of this issue is that these networks will be subject to disruption, and will therefore require sufficient robustness and adaptability to allow rapid reconfiguration. Access to operational theatres, whether physical or virtual, cannot be taken for granted. In virtual environments, both friendly and adversary forces will use the same nodes (technological hugging — the inability to cut access to networks on which both friendly and threat forces rely), and these may

be difficult to identify, protect or attack. Protection of our real and virtual networks against exploitation and attack is critical.[27]

35. By 2025, we may face adversaries with augmented cognitive capacity. The speed of unenhanced human decision-making may be insufficient to achieve success against an augmented adversary in a highly connected environment. The land force will need to develop a better understanding of enhancing man-machine interfaces, and even fusing technology with biology, in order to succeed in this environment. Targeted scientific research is necessary today to explore opportunities and threats associated with enhancing human decision-making and performance in the future operational environment. Increased automation within a networked force will deliver significant capability advantages. It will also present new vulnerabilities that a creative and innovative adversary may target and exploit.

36. From 2025, valuable communications nodes or logistics infrastructure are likely to be threatened and thus networks, both physical and virtual, will require protection from cross-domain attack. The trend towards integrated, interagency and joint operations will accelerate and the land force will become more integrated at lower levels and more dependent on external enabling capabilities and effects. Conversely, the land force will become increasingly vulnerable if dislocated from these capabilities by either adversary activity or adverse weather effects. The land force will focus on core functions while leveraging and exploiting external capabilities and effects organic to other services, other agencies and other nations. Despite this, prudent levels of resilience and redundancy must be maintained within the land force.

37. Finally, the connected and networked nature of the future environment may provide significant opportunity to leverage off civilian infrastructure in the conduct of future land force operations. Understanding how the land force can achieve such leverage is well worth further analysis.

A lethal environment

38. As long as land warfare requires the delivery of lethal effects to achieve military objectives, the weapons systems which deliver them remain fundamental to the way battles are fought. As combatants continue to strive to gain a lethal advantage, more sophisticated weapon systems will be required to achieve this. This has produced a continuous competition to develop greater capacity and effectiveness in applying lethal effects and a constant evolution in weapons technology. Consequently the weapons required to win future conflicts will differ markedly from those used to defeat adversaries today.

39. In recent conflicts Australian land forces have enjoyed a technological advantage over their opponents. However, adversaries continue to adapt their techniques and enhance the lethality of chosen weapon systems in an attempt to reduce this advantage. Terrorist groups and non-state actors with worldwide links and extensive financial resources will be able to acquire the means and knowledge of increased lethality through rapidly exploiting new and/or ‘dual use’ technologies such as weapons of mass effect.[28] Non-state actors are also unbounded by formal regulations that force them to fight conventionally. The state is losing its monopoly on the possession of advanced weaponry as commercially available technology, acquired legitimately or otherwise, is increasingly exploited by such groups to enable their operations. Future land forces must therefore be prepared to operate in an environment in which they are less likely to retain the technological advantage and thus must be able to recognise when adversary lethality increases in order to adapt.

40. Technological advances will continue to enable military forces to inflict greater damage on more targets at longer distances.[29] These advances have increased the ability of weapon systems to

detect, acquire, and prosecute multiple targets, significantly improving their capacity to deliver lethal effects. Improved munitions have considerably increased the range, accuracy and target end effect, both in terms of penetration and concussive effects, enhancing the individual impact of weapon systems. These advances are replicated across the spectrum of weapon systems employed by land forces including the individual assault rifle, helicopters and ballistic missiles. As new technology combinations are developed into new weapon systems, such as the fusion of combustion engine, machine-gun and armour plate to form the first tank, new counter-technologies are being developed, such as the anti-tank cannon, to defeat them. Consequently this competition is increasing the pace at which new and emerging technology is acquired and fielded in order to adapt to the changing level of lethality in the battlespace.[30]

41. Given the modernisation of militaries in our region, it is expected that fragmentation, anti-armour and anti-aircraft munitions will continue to proliferate in the Asia-Pacific area over the next decade.[31] Systems such as the RPG-7 series are likely to become more prolific due to their multi-purpose nature and their effectiveness against a variety of platforms. Advances in thermobaric and chemical warhead technology, adapted to simple weapon systems such as the RPG or the RKG series anti-vehicle grenade, provide a highly lethal, low signature individual weapon system. As the number of countries developing and acquiring these munitions increases, proliferation to non-state actors is probable, as they are attractive both in terms of low cost per unit and minimal training liability. As a result, the base level of protection and mobility required of land forces must be constantly reviewed and adapted in response to the ongoing proliferation of these munitions.

42. Lethal threats may also extend to those capabilities and platforms which provide strategic mobility and support to land forces. Regional powers armed with connected networks of long-range sensors, precision-guided missiles and other anti-access technologies may have the capacity to seriously inhibit the projection of land forces.[32] This has significant implications for Australia's amphibious capability and for strategic air transport. Already, ballistic missile capabilities can target an expeditionary force in its mounting base and anti-ship ballistic missiles, such as the Chinese DF-21D, are reportedly capable of targeting moving vessels out to 1500 kilometres from their point of release.[33] The land force must ensure it has access to, and is well rehearsed in different modes of strategic deployment to ensure resilience and the capacity to meet government requirements despite the actions of its adversaries.

43. **Implications of a lethal environment.** Advances in ultra-strong lightweight materials will have implications for the protection and mobility of land forces. Weight reduction through the improvement of armour plate, carbon fibre, ceramic and appliqué technologies will continue to improve combat body armour as well as the power to weight ratios of vehicles, enhancing physical protection, tactical mobility and endurance. Land platforms are therefore likely to increase in complexity with most if not all fitted with a variety of counter-measures, defensive systems and appliqué armour packages scaled and tailored to meet specific threat profiles.

44. Fixed infrastructure nodes, particularly headquarters and logistic areas based on sea and air ports, may become increasingly vulnerable due to their high physical and electromagnetic signatures. The land force may be required to develop dispersed headquarters and decentralised logistics infrastructure in its future operating concepts to reduce exposure to long-range remote attacks. Protection against these systems must therefore include the hardening of fixed installations and security of strategic mobility assets in secure home stations. The holistic application of signature management — in the electronic and visual realms — will be an integral element in ensuring the survivability of our command and control and logistics in the future operating environment.

45. Increased automation through robotics and artificial intelligence, enabled by more robust communications networks, will have a marked impact on the lethality of future land wars. Coupled with almost ubiquitous precision, and dense networks of unmanned sensor swarms, the capacity of humans to operate in such an environment will drive changes in individual and collective protection, the structure of forces and enhancements to human physical and mental capacity.

46. Unmanned systems will proliferate in the militaries of advanced nations throughout the region. Miniaturised sensor technology will reduce the detection thresholds of adversaries and place a renewed emphasis on defeating adversary information collection systems.[34] It will also drive the introduction of more unmanned and tele-operated systems — from sensors to explosive ordnance disposal and logistic systems.[35] Armed unmanned aerial systems and aerial sensors (and counter-unmanned aerial vehicle systems) are likely to proliferate and be utilised by both state and non-state actors. Capabilities such as the Switchblade system, recently deployed operationally by the United States Marine Corps, offer cheap, accessible lethality at the lowest level and will potentially populate the inventories of many nations.[36] These types of low-cost, accessible capabilities also offer opportunities for our Army in an austere budget environment to enhance the individual lethality of its soldiers. Conversely, non-state actors, including individuals, are likely to utilise three-dimensional printing to combine commercially available unmanned aerial systems with home-made explosives to achieve a Switchblade-like capability.

47. The rise of autonomous and remote systems is likely to result in lethality overmatches, with manned systems hampered by the need to sustain and support human crews. The integration of autonomous systems and pervasive computer networks allows the conduct of surveillance and/or military operations in remote/hostile locations at arm's length as well as the incorporation of a broader range of autonomous systems including ground and aerial logistic support.[37] Consequently, the level of human presence in close combat will be open to review in subsequent decades.

48. Given the likelihood of surprise in this environment, the ability to deploy highly survivable systems such as armoured vehicles, even if controlled remotely, should remain a priority. The ability of such vehicles to provide a supporting hub of communications, situational awareness and all-weather precision fires will enhance the capacity of the ground force to absorb surprise and achieve overmatch against an adversary. Key land systems such as the current M1 tank are due for replacement beyond 2025. While the threat, technological developments and limitations on strategic deployment may not permit a like-for-like replacement, the acquisition of a highly protected command and control hub with precision all-weather fire support should be investigated.

49. Beyond 2025, increasing levels of physical and mental robustness and resilience in soldiers will be essential. Emerging technologies that achieve advanced human performance present Army with opportunities worth exploiting. Likewise, the degree to which soldiers can be ethically enhanced also warrants investigation. Research into technological solutions that increase the survivability of soldiers in this environment or allow them to be removed from immediate danger altogether presents a valuable opportunity.

50. It is likely that unmanned systems with increasing levels of autonomy will proliferate in the militaries of advanced nations during the period 2025–2035. Continuing analysis of the speed with which this is likely to occur and the potential capabilities of these systems is essential. This will position Army to exploit the opportunities that this technology presents and provide protection against the threat (through cyber warfare or surface-based air defence capabilities) of adversary use. This will also require the alignment of joint and single service future operating concepts and the ability to ensure that they accurately account for the future capabilities and impact of autonomous systems.

A collective environment

51. The term 'collective' refers to a security or sharing arrangement, either regional or global, in which each party cooperates to form a cogent total response to common threats to, and breaches of, the prevailing order. This contrasts with self-help strategies designed purely to provide an immediate and individual solution. Sovereign nations eager to maintain the status quo, or deliberately attempting to alter the operating environment to their benefit, willingly cooperate, accepting a degree of vulnerability and, in the case of some minor nations, also acceding to the interests of the larger contributing nation organising the collective security. Collective action is achieved through the establishment of a cooperative; this gives rise to a form of international collective governance, albeit limited in its scope and effectiveness. The collective organisation then becomes an arena for diplomacy, technology transfer, the airing of balance of power issues and the legitimate exercise of national power.

52. The last two decades have seen an increasing trend towards collective, joint, coalition and interagency military operations.[38] Australia's plans to work with security partners to standardise equipment, doctrine, training and information and intelligence systems are well advanced and are formalised through agreements such as the Australia, Canada, Britain and America program and through treaties and alliances such as that between Australia, New Zealand and the United States (ANZUS). The maintenance of an organic defence industry has also represented an important facilitator in collective problem-solving and information-sharing between Australia and her partners.

53. Collective arrangements signal an enhanced relationship between Army and other elements of the Australian Defence Force and with other government and non-government agencies of national power. Army, as part of the Australian Defence Force, has long attempted to unify these disparate constituent elements into a single functional component. Joint and interagency operations require integrated and synchronised application of all functions of national power. The synergy that results maximises combat capability in a single, unified action. Placing priority on national and international unities of effort means that practitioners of future warfare will learn to acknowledge and employ the interagency process in all aspects of military planning and employment.

54. **Implications of a collective environment.** Army will continue to contribute land forces to joint, interagency, inter-governmental and multinational activities to 2035. Land force operations will be affected by all of the five environmental domains — sea, land, air, cyber and space. This reality represents a natural extension to Army's current concepts of military operations in the littoral environment, in which sea, air and land domains interrelate.[39]

55. Risks and threats to the land force will increase across all domains or through asymmetric effects perpetrated by either known or unknown protagonists. The emergence of a contested and increasingly active cyberspace in particular will have a profound influence on the conduct of land force operations. Army will have to rely on other arms of the Australian Defence Force as well as external partners to effectively operate in a cyber-hostile environment. Future 'war' in the cyber domain is likely to assume the form of continuous and persistent conflict — this will be the norm rather than the exception.[40] In this realm, Army is dependent on the collective work of others as it seeks to concentrate its efforts at decisive points within a military operation.

56. Land forces must train and experiment with the other services to develop joint capabilities. Internationally, an embedded, integrated approach will be central to working with our principal ally, the United States, as well as other regional partners. Foremost among these capabilities are command, control, communications, computers, intelligence, surveillance and reconnaissance and network-centric capabilities. The United States will continue to exploit the latest technological

advances in the future development of its military forces. Consequently, Army must be able to 'plug into' these (and other global systems) if it is to sustain the skills to effectively contribute to decisive combat operations in a multinational operation. Significant political, military and commercial investment will be required, not least in the fields of defence cooperation, technology transfer and intelligence-sharing.

57. Army's individual and collective training must also focus on developing commanders capable of intuitively understanding, utilising and exploiting joint and interagency capabilities. Thus, Army will need to review the manner in which the joint force exercises command and control of any joint interagency task force which it commands or to which it contributes. A review of the Military Appreciation Process for operational planning in a collective environment is essential to facilitate this. The adoption of common joint processes for operational planning and staff cycles that are communicable to all stakeholders is also fundamental to developing a future effective force.

58. Over the last two decades, the Australian Defence Force has progressively become a more joint force with the formation of Headquarters Joint Operations Command, Commander Joint Logistics, Commander Joint Health, enhanced joint concepts, and the formation of additional joint units. There is potential for 'jointery' to continue its expansion into areas such as force generation and organisation over the next two decades. As such, Army must not only contribute to this approach, but assess how this enhanced 'jointery' might impact on Army itself.

59. Beyond 2025, the synthetic training environment is likely to provide an increasingly capable and cost-effective means of conducting individual and collective training. The creation of a joint synthetic training environment that enables the land force to train within a joint, interagency, inter-governmental and potentially multinational military community will be required. This will become increasingly crucial to maintaining capability, particularly as the Army faces increased fiscal challenges.

A constrained environment

60. Land force operations in the future operating environment will be affected by a decreasing recruitment pool, fiscal austerity, ethical and social expectations from a more socially aware population, and domestic and international legal norms.

61. Currently, Army's target recruitment pool relies heavily on 18 to 24-year-olds. While Australia's population is expected to continue growing to 2050, the rate of growth will slow and the ageing population will result in a reduction in labour force participation. Currently, lateral hire is difficult to achieve, effectively shrinking the recruitment pool and continuing to encourage a 'grow your own' recruit-to-retire cycle.[41] In addition, future 18 to 24-year-olds are more likely to be seeking multiple career opportunities over an extended career both now and into the future.[42] These factors, combined with the predicted decline in the proportion of younger workers in Australia and falling education performance, are cause for some concern over the Army's ability to meet capability demand.

62. Defence is also entering an era of fiscal austerity at a time when meta-trends and indicators suggest increased land force roles. If Army is to provide the full spectrum of land force requirements in an uncertain future it must maintain the core capabilities of combat, combat support, combat service support and command support functions. Advancing and convergent technologies may assist in this endeavour without placing excessive demands on a limited defence budget.

63. Aside from financial constraints, Western ethical and social norms will continue to place restrictions on the conduct of future operations. The increasing difficulty of discriminating between combatants and non-combatants is likely to require more extensive targeting preparation. Furthermore, the moral requirements to take all feasible precautions in avoiding, or at least minimising, collateral damage and casualties has seen an increased use of precision weapons. However, the use of such weapons still carries risk. The public awareness of battlespace operations continues to rise as news services and media become more pervasive.

64. At present, international legal norms restrict the use of some more advanced weapons and systems, such as unmanned aerial systems, directed energy weapons and non-lethal weapons. Such legal, moral or ethical constraints, which uphold the legitimacy and legality of Western military operations, rarely restrict the actions of potential adversaries.[43]

65. **Implications of a constrained environment.** For the Australian Defence Force in the next decade, a depleted recruitment pool may see an expansion in targeted employment campaigns, creating an increasingly diversified force in age, gender and ethnicity. Out to 2025, Defence may need to increase and enhance incentives to retain personnel for longer time periods. The land force will also work more closely with established allies and emerging defence partners through increased information and resource-sharing and pooling. Other strategies to combat a shrinking recruitment pool and fiscal austerity include leapfrogging (cutting defence expenditure today while concurrently investing in future capabilities), establishing informal ad hoc coalitions and increased burden-sharing.

66. The next decade is likely to result in significant financial constraints for the Australian Defence Force. While there is a minimum level of capability that the land force must be capable of achieving in order to provide response options to government, the land force is yet to identify and prioritise the core effects that it must generate within this operating environment. Such identification and prioritisation is also required in order to determine the nature and level of joint and interagency support that it requires in order to generate such capability. Further analysis in this area will be essential to accurately guide force development in a fiscally austere environment.

67. As a result of this prioritisation, the land force may need to retain the capacity to regenerate shelved capabilities that are not cost effective for the immediate future. Plans may need to be developed to maintain an embryonic capability including technical expertise and skill sets. The land force may also need to look to its allies and partners who possess such capabilities and seek to maintain competence through information and personnel exchange. The ramifications of such policies and means of mitigating a capability loss require careful analysis. Likewise, the efficient use of affordable technology, combined with a greater premium on operating with partners and allies, for the delivery of massed precision kinetic and non-kinetic effects is also worthy of further examination.

68. In the future operating environment, increasing physical demands will be placed on a decreasing number of personnel. While the means to enhance human physical and cognitive performance already exist, the land force will be limited in its ability to do this in an ethical manner over the next decade. This is primarily due to the long-term health concerns associated with many of these measures. However, the potential benefits to land force capability are such that enhancing human cognitive and physical performance is worthy of further research and analysis. Developments in material science may also be utilised to improve resistance to extreme pressure, create greater elasticity and advance tensile strength. This will alter the way in which logistics are organised and may assist in further protecting land forces.

69. The future constrained environment is likely to demand reduced levels of collateral damage and associated increases in the levels of precision required. The use of non-precision weapons, or the failure of precision weapons to avoid collateral damage, while legally permissible, may generate adverse public perceptions that undermine the legitimacy of operations. Public perception and the role of the media must be considered. Concerns over the proportionality of the use of non-precision weapons are likely to lead to attempts to further minimise their use. Analysis into the ramifications of the level of intelligence, surveillance and reconnaissance effort, collateral damage estimate methodologies, the use of non-lethal/immobilising technologies and precision munitions is also warranted. These concerns are likely to result in policy constraints on the use of such technologies and may lead to new international treaties and rules of engagement.

70. International legal restraints will be prominent over the next decade as Australia increases its activities in multinational arenas and furthers commitments to international ideals such as security, stability, transparency and cooperation. For example the United Nations Arms Trade Treaty regulates the global trade of conventional arms and will govern the actions of the Australian Defence Force in the employment of armoured combat vehicles, missiles and small arms, to name a few.[44] This coexists with Australia's numerous historical obligations including commitments to the Geneva Conventions, Rights of the Child and the Law of the Sea.

71. The post-2025 operating environment could see further restrictions on emerging technologies. At present, autonomous technology is in its infancy; however, in time the effect of autonomous systems on the conduct of future war is likely to be profound. But questions remain concerning the ethics and legality of the arming of autonomous platforms and the empowering of these systems to use lethal force. The land force will require a detailed understanding of the feasibility and acceptability of the arming of autonomous systems and their lethality post-2025. This will need to include the potential responses to the use of such systems by threat forces. A fundamental dilemma that may arise involves widespread adversary use of such systems in an environment in which ethical considerations prevent their use by the Army.

Convergence

72. Each of the five meta-trends examined in this report will impact on conflict in the future and, consequently, on the design of the future Australian Army. However their impact will not occur in isolation — the five meta-trends will overlap and converge. This convergence will only serve to further increase the complexity of the future operating environment. It will drive further uncertainty and confound our capacity to understand many aspects of the theatres in which we operate.

73. The crowded urban environments in which we are most likely to operate will also contain dense connected networks. While for military forces the use of these networks is generally relatively benign, recent experience has shown, however, that non-state threats have developed a sophisticated understanding and ability to exploit civil communications networks to coordinate their activities, gain information and shape public perception. Access to satellite imagery, precision geo-location and timing, and communication through various electronic means (including social media), all provide opportunities for threats against our forces.

74. The connectivity within these crowded environments will also underpin the enhanced lethality of these environments. The capacity of a variety of threats to collect and share information will improve the precision of attacks on our forces. These attacks may be physical but will almost certainly be conducted in the cyber realm as well. Connectivity will provide opportunities for the exploitation of incidents — and shaping of local perceptions — in which our forces may inadvertently injure or kill civilians. This in turn will continue to foster the strategic constraints,

evident in contemporary operations, which are likely to remain an enduring feature of the operating environment.

75. While it is possible to identify signs of this convergence, the nature of human interaction dictates that it will generate unforeseen and unanticipated events. This uncertainty — an enduring element of warfare — drives the continuous requirement for us to strive for high levels of intellectual and physical resilience in our people and units. This resilience will provide the foundation for an adaptable and relevant land force and one that can operate and succeed in the most arduous of operational circumstances.

CONCLUSION

76. The nature of war is enduring and the actions of individual soldiers, enabled by their training and technologically advanced equipment, will remain the most integral component of the future Australian Army. The environment in which wars are fought continues to evolve however, and thus Army's future land force must be capable of surviving and thriving in an operating space that is crowded, connected, lethal, collective and constrained. These operations will be conducted across land, sea, air, cyber and space domains.

77. Over the coming decade, the Army is likely to face its most demanding intellectual and emotive challenge — providing a rationale for the maintenance of ready and relevant land forces in the face of constrained defence budgets. And, short of a direct threat to Australia, the public appetite for the deployment of Australian land forces overseas is likely to diminish.

78. Notwithstanding this environment, initiatives such as Plan Beersheba allow Army to transform to meet a new security environment, focused on the power of joint effects (particularly amphibious operations) and decisive action. Success will be demonstrated by Army's power, as part of a joint force, to initiate, conduct and conclude military operations. Integration and interoperability will be critical issues in joint, combined and coalition operations noting that there will always be disparities among participants in the areas of military capability and technological development. The environment will inevitably be the urban littoral, characterised by the five meta-trends identified in this report. Army must be in a position to identify, analyse and thrive in the future land warfare environment if it is to remain an effective instrument of policy in support of the Australian Government.

79. Future operations will be necessarily joint, and will require fused planning, decision superiority, and overmatching power — applications that will have significant implications for coalition and alliance interoperability. Success in any future war will be largely dictated by Army's ability to contribute to the achievement of these joint effects, drawn from all elements of national power, in a truly joint and integrated way. A network-enabled approach that achieves decision superiority through support tools capable of generating rapid information exchanges will enable the application of overmatching power at decisive points, be they kinetic or non-kinetic in their composition.

80. The Future Land Warfare Report describes the projected future operating environment and suggests how it may influence Army's future land force. This report enhances and refines the description of Army's current future force development as detailed in *Complex Warfighting 2004* and *Adaptive Campaigning Future Land Operating Concept 2009.*

81. The Future Land Warfare Report is also designed to invigorate, refocus and prioritise Army's capability-based and concept-led approach to modernisation, while also informing the Chief of Army's Modernisation Lines of Inquiry. While today's changing global environment continues to challenge our common assumptions, accelerating technologies in which information and precision dominate also make it increasingly difficult for Army to marry this technology with its core tasks in what is an increasingly cost-conscious Australian Defence Force. Against such a backdrop, this analysis of future land warfare and its implications for the Australian Army is critical, given that an intimate understanding of these implications remains at the heart of Army's operational art and pervades all Army's doctrine and training.

Endnotes

[1] Government of Australia, *Defence White Paper 2013*, pp. 9–11.
[2] Major discontinuities that could potentially disrupt our regional or the global environment include:
major state-on-state global conflict; a regional or global disease pandemic over-stressing public health systems and economies worldwide; rapid climate change or a significant natural disaster adversely affecting population flows, sovereign integrity and environmental damage; the collapse of the United States' global dominance as a result of financial crisis, a major terrorist attack provoking an isolationist response, or defeat in a major conflict; the demise of the nation-state due to increased population mobility and pressure from supra-national and sub-national entities; the development of breakthrough technologies rendering even the most advanced forms of warfare in 2013 obsolete, thus erasing the capability edge of the major powers worldwide.
[3] The term 'crowded' encompasses a range of factors that interplay to create complex human, informational and urban physical terrain, including urbanisation, rural to urban migration, population growth, resource scarcity and environmental and regional political instability.
[4] The term 'connected' refers to the flattening effect that interconnected global economic, social and communications systems will have on the future operating environment.
[5] The term 'lethality' describes the effectiveness of a weapon system or object in inflicting death and the destruction of materiel. The ability to produce high levels of lethality is not restricted to nation states and regular armed forces. Land forces may encounter individuals or groups with extremely high lethality in any type of operation.
[6] The term 'collective' refers to a security or sharing arrangement, both regional and global, in which each party cooperates to form a cogent total response to common threats to, and breaches of, the prevailing order.
[7] The term 'constrained' is used to encapsulate limitations and restrictions that will define, influence and constrain the way the land force conducts future land warfare.
[8] National Intelligence Council. 2012. *Global Trends 2030: Alternative Worlds*, p. iv.
[9] Ibid., p. v.
[10] Population Division of the Department of Economic and Social Affairs of the United Nations, 'World Urbanization Prospects, the 2011 Revision' (2012), http://esa.un.org/unup/Maps/maps_urban_2025.htm, p. 4 [Accessed 3 Oct 2012].
[11] Ibid.
[12] These are: Mumbai, Tokyo, Seoul, New York City, Mexico City and Karachi.
[13] Canadian Forces, Chief of Force Development, 'The Future Security Environment 2008-2030', http://www.cfd-cdf.forces.gc.ca/documents/CFD%20FSE/Signed_Eng_FSE_10Jul09_eng.pdf , p. 23 [Accessed 3 Oct 12].
[14] Australian Army, *The Future Land Warfare Report 2022-2035*, Canberra, 2012, p. 9.
[15] 'The Future Security Environment', p. 31.
[16] 'World Urbanization Prospects, the 2011 Revision', p. 18.
[17] Pacific Institute of Public Policy, 'Climate Security', 23 March 2012.
[18] Australian Army, *Future Land Operating Concept 2011*, pp. 18–19.
[19] For China and India's growing use of space-based assets, see Ashley Tellis, 'China's Military Space Strategy', *Survival*, Issue 49, No. 3, 2007, pp. 41–72; Deganit Paikowsky and Isaac Ben-Israel, 'India's Space Program: An Israeli Perspective on Regional Security', *India Review*, Issue 10, No. 4, 2011, pp. 394–405.
[20] United Kingdom Ministry of Defence, Defence Concept Centre, *Op. cit*., p.21-22
[21] For how China will seek to dominate the electronic spectrum, see United States Department of Defense, *Military and Security Developments Involving the People's Republic of China 2010,* Office of the Secretary of Defense, Washington DC, 2010, p. 25.
[22] Department of Defence, *Defence Capability Guide*, 2012, p. 19.
[23] Ibid., p. 21.
[24] Ibid., p. 24.
[25] *Military and Security Developments Involving the People's Republic of China 2010*, pp. 25–26.
[26] Royal Australian Navy, 'The economic importance of submarine cables', *Semaphore: Newsletter of the Sea Power Centre Australia,* Issue 2, June 2012.
[27] United Kingdom Ministry of Defence-Defence Concept Development Centre. 2010. *Op. cit*., p.24
[28] *White Paper 2009*, p. 23, para. 2.25.
[29] D. Deason and M. Lewis, 'The War Fighter's Need for Science and Technology', *Air and Space Power Journal*, Vol. XIX, No. 4, Winter 2005, pp. 12–25.
[30] See Max Boot, *War Made New: Weapons, Warriors and the Making of the Modern World*, Gotham Books, US, 2006. The work of Williamson Murray has also been vital to our understanding of the development of military technology and innovation.
[31] Boot, *War Made New*.

[32] Much attention in this area has been focussed on the growing anti-access/area-denial capabilities of China. See Tom Mahnken, 'China's Anti-Access Strategy in Historical and Theoretical Perspective', *Journal of Strategic Studies*, 8 September 2011, pp. 299–323.
[33] B. Spegele, 'China: aircraft carrier now in service', *Wall Street Journal*, 25 September 2012 at: http://online.wsj.com/article/SB10000872396390444358804578017481172611110.html [accessed 3 October 2012]
[34] 'The Future Security Environment', p. 72.
[35] Unmanned aerial logistics have already been deployed operationally by the USMC in Afghanistan, employing the K-max helicopter system. See C. Hoyle, 'USMC extends K-Max mission in Afghanistan', Flight global online at: http://www.flightglobal.com/news/articles/usmc-extends-k-max-mission-in-afghanistan-384010/ [accessed 28 March 2013]. See also: http://www.kaman.com/aerospace/helicopters/products-services/k-max/ [accessed 1 April 2013]
[36] For a description of this armed, short-range unmanned aerial vehicle system, see S. Ackerman, 'U.S. Troops Will Soon Get Tiny Kamikaze Drone', *Wired Magazine* (online), 18 October 2011 at: http://www.wired.com/dangerroom/2011/10/tiny-kamikaze-drone/ [accessed 1 April 2013]
[37] For the use of robotics in telepresence operations, see 'Your alter ego on wheels', *The Economist*, 9 March 2013 at: http://www.economist.com/news/technology-quarterly/21572916-robotics-remotely-controlled-telepresence-robots-let-people-be-two-places?frsc=dg%7Ca [accessed 1 April 2013]
[38] United States Department of the Army, 'Knowledge and Speed: Battle Force and the U.S. Army of 2025' (published 1998), p. 16, at: http://legacy/TeamWeb2010/ARMY/ahq/mspdivision/SP-A/dara/Concepts/Supporting%20Concepts/Future%20Land%20Warfare/Knowledge%20and%20Speed%20Battle%20Force%20and%20the%20US%20Army%20of%202025%20-%20AAN%20Report%201998.pdf [accessed 2 April 2013]
[39] Future Land Warfare Branch*, Land Warfare Doctrine 1*, Canberra, 2008, p. 30.
[40] Australian Army, *The Future Special Operating Concept (FSOC) 2030,* Canberra, 2009, p. 4.
[41] Australian Army, *The Army People Plan*, Canberra, 2013.
[42] C. Stoker and S. Mehay, *Recruiting, advertising and marketing strategies in all-volunteer force nations: case studies of Canada, Australia, the United Kingdom, and the United States*, Naval Postgraduate School, Monterey, California, 2011.
[43] UK Ministry of Defence-Defence Concept Development Centre. *Op. cit*., p.25
[44] This treaty was approved in March 2013 and, once implemented, will 'establish the highest possible common international standards for regulating or improving the regulation of the international trade in conventional arms.' Australia's Ambassador to the United Nations, Peter Woolcott, presided over the Arms Trade Treaty Conference. The conventional arms covered by the treaty are: battle tanks, armoured combat vehicles, large-calibre artillery systems, combat aircraft, attack helicopters, warships, missiles and missile-launchers, small arms and light weapons. For more, see http://www.un.org/disarmament/ATT/docs/Draft_ATT_text_27_Mar_2013-E.pdf