Chapter 5
Technological Change and Future Security in the Indo-Pacific: An Australian Perspective

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Introduction

In 2020, the launch of Australia's Defence Strategic Update, and its accompanying Force Structure Plan, on 1st July 2020 by Prime Minister Scott Morrison, set the basis for future development of Australian defence policy and military strategy, and the future force structure of Australian Defence Force (ADF) in coming decades.[1] Both documents highlighted the importance for new types of military capability for the ADF, ranging from enhanced long-range strike through to sovereign space capability and investment in autonomous systems.

More recently, the signing of the 'AUKUS' agreement on 16th September 2021 opens new opportunities for Australia to invest in new types of critical and emerging technologies that could transform our approach to military operations in the Indo-Pacific and allow us to undertake a paradigm shift in our approach to military affairs.[2] Certainly, the most prominent aspect of AUKUS was the decision by Australia to acquire nuclear powered (but not nuclear-armed) submarines. However, an arguably more important and immediate outcome will be cooperation in areas such as artificial intelligence (AI), quantum technology, autonomous systems, hypersonics, cyber and space capabilities.

These and other areas of critical and emerging technologies will have a decisive impact on not only the character and conduct of future warfare but will likely reshape the geopolitical and military dynamics of the Indo-Pacific. The significance of embracing rapid innovation and change in military affairs, highlighted by both the 2020 Defence Strategic Update and then the 2021 AUKUS agreement has been reinforced by two further key developments – the 2021 AUSMIN summit in Washington DC, and then the Quad summit. The AUSMIN summit was important in expanding force posture arrangements in terms of allowing greater access for US forces to Australian facilities and territory and expanding cooperation in areas such as space and cyber.[3] The historic Quad summit expanded our links with Japan and India in areas of critical and emerging technologies that have military application, and expanded our cooperation with key

partners in key areas such as space, maritime domain awareness, and cyber security, amongst other areas of cooperation.[4]

These important developments in Australia's geopolitical role are not occurring in a strategic vacuum. They are occurring against a strategic context of intensifying strategic competition between a rising authoritarian China and the United States, and its key allies, including Japan and Australia. In terms of military capabilities that will decide this competition, the answer may very well not be traditional 'legacy' systems such as warships, aircraft, or ground forces – though those will remain highly important – but advantage in new domains, such as space and cyberspace, and with critical and emerging technologies.

This paper seeks to explore how these new types of military capability will play a role in this more dangerous strategic future, using current Australian defence policy as a starting point, and exploring likely next steps in terms of ADF capability development and force posture.

Technological change and Australia's strategic context

Australia faces a more precarious and unpredictable strategic environment in 2021 than perhaps at any time since the conclusion of the Second World War in 1945. The rise of an assertive People's Republic of China which is challenging security across a free and open Indo-Pacific, whilst rapidly modernising and expanding its military, is resulting in intensifying strategic competition between Beijing and Washington DC.[5] China seeks to challenge US strategic primacy in the region, in a manner that would be catastrophic for US interests. Likening current US-China competition to the ancient game of 'go', Rory Medcalf notes that

> "Over the past decade, the Chinese leadership has chosen to confront Japan in the East China Sea, Vietnam and the Philippines in the South China Sea, India on the disputed border and United States across the global board, from the western Pacific to cyberspace…" and argues that
> "Alone among the great powers, China's Indo-Pacific strategy connects directly with the survival of the domestic political system and the vested interests of the leadership."[6]

In other words, for the Chinese Communist Party (CCP) leadership, and especially

for President Xi Jinping, their legitimacy and grip on power depends on achieving the 'China Dream' of a rejuvenated China that is a rich country with a strong army. Success and continued political legitimacy demand that China resolves territorial disputes in a manner that overturns a perceived 'century of humiliation' lasting from the beginning of the Opium Wars in the 19th century through to the end of the Second World War and China's civil war in the mid-20th Century. Resolving these territorial disputes – the unification of China and Taiwan, China's claims to disputed territories and maritime zones in the South China Sea encircled by a Chinese drawn 'nine-dash line', and China's claims to the Senkaku islands in the East China Sea – are essential if the 'China Dream' is to be achieved by 2049, the centennial of the formation of the People's Republic of China.[7] China also has territorial disputes with neighbouring India in the Himalayas, which has recently generated increasing tension and even skirmishes between Chinese and Indian forces.

More broadly, China's rapid modernisation and expansion of the People's Liberation Army (PLA) is upending strategic dynamics that have traditionally favoured US power.* The growth of Chinese military power is occurring broadly in two trajectories. Firstly, the development of a counter intervention capability based around highly capable and increasingly long-range anti-access and area denial (A2AD) systems that will allow China to effectively raise the cost of US military intervention into the western pacific in a crisis to unacceptable levels, and strike at forward deployed US forces within the first and second island chains.[8] Secondly, China is building power projection capabilities, based around the world's largest Navy, together with Chinese Coast Guard and maritime militia vessels. The objective is to protect Chinese interests, including its diaspora and to ensure access to key resources in far flung deployments well beyond the first island chain (see map 1).[9]

China's Belt and Road Initiative (BRI), and notably, the 21st Century Maritime Silk Road, aligns neatly with these key interests from the South China Sea into the Indian Ocean, to access vital energy resources from the Persian Gulf, and through the Red Sea and Suez Canal into the Mediterranean Sea to markets in Europe.[10] The establishment of Chinese bases in Djibouti and more recently in Cambodia, and an attempt to establish a base in the UAE, is matched by dual-use commercial ports and airports, constructed under the BRI that ultimately, will support PLA power projection to the far seas and far oceans.[11]

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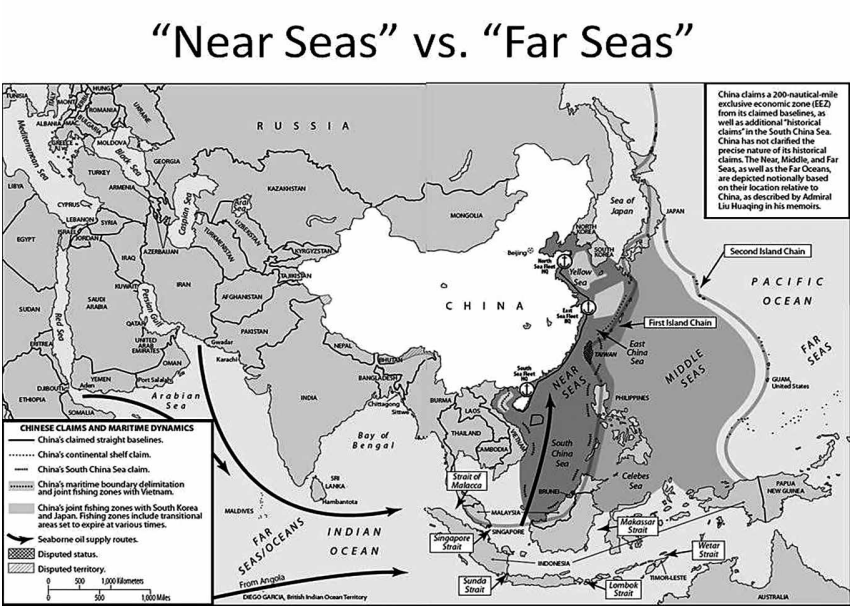
* The People's Liberation Army includes not only the ground forces, but also PLA Navy (PLAN), PLA Air Force (PLAAF), PLA Rocket Forces (PLARF), PLA Strategic Support Force (PLASSF), PLA Joint Logistics Support Force, and People's Armed Police



Source: Andrew S. Erickson, Abraham M. Denmark, Gabriel Collins, "Beijing's 'Starter carrier' and Future Steps: Alternatives and Implications", *Naval War College Review*, 65.1 (Winter 2012), p. 22-23.

At the same time as China is expanding its military power and physical presence, it is promoting an alternative model of governance and development that challenges the dominance of western liberal democracy. This, in effect, amounts to an ideological challenge to western interests and Chinese actions would challenge the assumption by many western commentators and academics that the current growing tensions between China and the United States are not indicative of a new Cold War. H.R. McMaster notes that

> "China has become a threat because its leaders are promoting a closed, authoritarian model as an alternative to democratic governance and free-market economics. The Chinese Communist Party is not only strengthening an internal system that stifles human freedom and extends its authoritarian control; it is also exporting that model and leading the development new rules and a new international order that would make the world less free and less safe."[12]

Key regional US allies, including Japan and Australia, are responding to this comprehensive global challenge, and the growing risk of major power war emerging from these potential flashpoints by shifting defence policy in major new directions. The previous close focus on global counterterrorism has been replaced by a greater priority towards countering major power threats from China, as well as Russia. In particular, the possibility of a crisis emerging across the Taiwan Straits within this decade is now concentrating the minds of defence planners and strategic thinkers in Washington, Canberra, and Tokyo, as well as other capitals.[13] In Australia there is an increasingly active debate on the prospect for a cross-straits conflict, and how Australia should respond in the event that the United States, in choosing to support Taiwan in the face of a Chinese attack, calls on Canberra to assist its operations.[14]

With this deteriorating security outlook in mind, it is therefore no surprise that Australia's 2020 Defence Strategic Update (DSU), and its accompanying Force Structure Plan (FSP), released on 1st July 2020, alluded to a more contested and dangerous strategic outlook. The DSU highlights growing risks of major power war, potentially between China and the United States, noting that

> "Strategic competition, primarily between the United States and China, will be the principal driver of strategic dynamics in our region."[15]

and continues to state that

> "Major power competition, coercion and military modernisation are increasing the potential for and consequences of miscalculation. While still unlikely, the prospect of high intensity military conflict in the Indo-Pacific is less remote than at the time of the 2016 Defence White Paper, including high-intensity military conflict between the United States and China."[16]

The 2020 DSU also withdrew the traditional assumption of a period of ten years of strategic warning time, which has been a central feature of Australian defence policy since the late 1980s, stating that

> "Previous Defence planning has assumed a ten-year strategic warning time for a major conventional attack against Australia. This is no longer an appropriate basis for defence planning."[17]

The DSU highlights the challenges of growing coercion, competition, and grey-zone activities by China, directed against Australia and growing military capabilities appearing in the region that undermine the credibility of a ten-year period of warning time. The DSU also notes accelerating military modernisation driven by long-periods of economic growth, which is now undermining Australia's traditional military-technological advantages. It points to the introduction of "…advanced strike, maritime surveillance, and anti-access and area denial technologies, which have implications for Australian operations in the region."[18]

Finally, the DSU highlights emerging and disruptive technologies, including "… sophisticated sensors, autonomous systems and long range and high-speed weapons", as well as expanding cyber capabilities.[19]

With these trends clearly emerging, Australia is moving to invest in a range of new types of military-technological capabilities to meet the challenge posed by China's growing military power. Perhaps most significantly are investment in new long-range strike capabilities, initially alluded to in the 2020 Force Structure Plan (FSP), and then 're-announced' in the AUKUS agreement. Also of key importance were agreements to collaborate in new types of military technology areas, with AUKUS stating that areas to be considered initially would include "…cyber capabilities, artificial intelligence, quantum technologies, and additional undersea capabilities."[20]

The 2020 FSP also reinforces these priority areas, and in addition highlights the growing importance of space as an operational domain, noting that 'Space Control' is now a key task for Defence.[21] The elevation of the Space Domain, and the importance given to acquiring sovereign space capability, is a key step in opening up a broad range of new types of military capabilities for the ADF, including long-range strike, sovereign controlled space-based intelligence, surveillance and reconnaissance (ISR) and positioning, navigation and timing (PNT), and advanced logistics. The decision by Defence to establish a Defence Space Command as of 2022 reinforces this important step towards a more sophisticated approach to space operations.[22]

These recent developments in Australian strategic policy highlight a recognition of the importance of critical and emerging military technologies, and new operational domains in future warfare. Although the nature of war hasn't changed from its Clausewitzian fundamentals, the character and conduct of military operations are being transformed as new technologies, in particular, those emerging from civil and commercial sectors, are being adapted for military roles. Traditional air, naval and land forces remain of key importance, but the changing strategic environment, and the acceleration of technological

innovation as well as the importance of space and cyberspace as operational domains, are driving the embrace of new types of capabilities.

For Australia, there are risks and opportunities inherent in new domains and emergent technologies. A clear risk that is generating growing debate within Australia's strategic policy community is the growing disconnect between the clear dangers inherent in a rapidly worsening strategic outlook against the slow pace of military capability acquisition managed within Australia's defence organisation.

Recent steps such as AUKUS and the 2020 Defence Strategic Update suggest that Australian decision-makers are clearly ready to invest in emerging technologies. However, this is constrained by investment in major capability projects, for example, the Navy's *Hunter* class future frigates and the decision to acquire nuclear powered submarines under AUKUS.[23] A decision to proceed with substantial investment into new armoured fighting vehicles (AFVs) for Army under defence project LAND-400 Phase 3, continues to reinforce a more traditional approach to capability acquisition that is ill-suited to a more unpredictable strategic environment, and does not consider the practical aspect of how large and heavy AFVs can contribute to tactical or operational success in what is likely to be primarily an air, sea, space and cyber war in any probable future contingency involving China.[24] This approach to acquisition is slow, measured over project cycles of decades, and often emphasises a 'like for like' replacement mindset of incremental improvement that replaces older capability with similar numbers of more modern but similar platforms, rather than explore entirely new force structures better appropriate to radically different operational environments. Such an approach will be quickly outpaced by both events in a rapidly evolving region, and by the accelerating pace of technological change. The risk of project delays and cost overruns further raises the risk of capability gaps emerging.

Furthermore, the emphasis in current ADF force planning remains on small numbers of very expensive, 'boutique' capabilities which reinforce a brittle force in terms of combat sustainability in a high-intensity interstate or major power war contingency. Such an approach to ADF force structure, very appropriate for past strategic environments that was largely absent of a major power threat, and which enjoyed a ten-year strategic warning time, is no longer necessarily 'fit for purpose' in the future challenges facing Australia.

Clearly, it is time to challenge outdated paradigms for capability development, and a key step must be for the Australian defence organisation to be willing to accept change. Now is the time for such a shift in mindset, which can only be led from the top-down

at the direction of government, whilst new ideas on how best to shape the future ADF take hold. Australia *can* exploit new opportunities in investing in emerging technologies and building capabilities for new operational domains including space and cyberspace. AUKUS, and the 2020 DSU and FSP, together with collaboration with other partners, such as Japan and India through the Quad, open new pathways for Australia to take different approaches to building the future force, and ideally, accelerate the acquisition of advanced military capabilities more suitable to meeting the challenges on the horizon. It is vital for Australia that it rapidly moves to respond to a more demanding strategic context with new types of military capability, and shape ADF military strategy to best respond to a new era in Australian defence policy.

Key themes in the technology of future war

The most important force structure decision emerging from the 2020 Defence Strategic Update and the Force Structure Plan was a recognition that Australia needed advanced long-range strike capabilities in the face of growing Chinese military power, including, the development of Chinese long-range ballistic and cruise missiles armed with conventional warheads. The upgrade to Australia's long-range strike capabilities will initially be based around current missile systems such as the AGM-158C Long-range antiship missile (LRASM), of which up to 200 will be acquired, together with other systems such as Joint Air to Surface Attack Missile Extended Range (JASSM-ER) and the Tomahawk Land-attack Missile (TLAM).[25] However, the FSP also highlighted growing investment into much more capable hypersonic weapons for future acquisition. The AUKUS agreement reinforced the importance of long-range strike in the ADF.[26] Finally, the decision to establish local manufacturing of advanced missile systems gives Australia the ability to address challenges associated with combat sustainability in the face of high intensity major power war, especially if that war is protracted in nature.[27] It seems unlikely that global supply chains for such missiles would be sustainable in such a scenario, demanding sovereign missile production.

The acquisition of these new strike capabilities, and the decision to proceed with sovereign missile manufacturing, marked the end of a traditional mindset that largely saw the ADF undertake a 'defence in depth' approach to 'Defence of Australia' task from behind or inside the 'sea-air gap' to Australia's north and west, relying heavily on the United States for direct military assistance. Instead, Australia would seek to achieve greater self-reliance and project military force well forward of that notional strategic

'moat', which no longer provided any degree of operational and tactical protection against a range of emerging missile and non-kinetic threats. Chinese long-range anti-access and area denial capabilities meant that Australia had to defend its territory deep into the Indo-Pacific region. It's growing cyber, counter-space and electronic attack capabilities add to the risk posed by a positional defensive posture that is limited in reach and purely defensive in nature. The transition towards hemispheric operations could be seen to be a shift towards a form of 'forward defence in depth.' [28]

But to make such a strategy viable, the Defence organisation and the ADF now need to consider acquiring a panoply of emerging military technologies that could reshape the ADF to ensure it remains operationally relevant and fit for purpose in future war. Some broad themes of future war can be summarised as follows, which should guide future ADF capability development, and thus, shape Australia's ability to 'shape, deter and respond' across the Indo-Pacific region. [29]

Accelerating tempo of operations

Future warfare is likely to occur at a much faster pace, in terms of the generation of precision kinetic and non-kinetic effects over long range, and in terms of battlespace command and control. The impact of varying degrees of automation and high speed in military systems of systems will exceed the ability of human decision-makers, including political leaders, to manage. This will increasingly demand greater investment by Australia in artificial intelligence (AI) and there is a requirement to move more rapidly towards enabling varying degrees of autonomy across a complex, multi-domain operations environment.

The speed and pace of future military operations in a complex multi-domain battlespace is likely to occur over very long range, particularly in the Indo-Pacific region. The growth of China's long-range missile capabilities will challenge the ability of US and allied air and naval forces to project presence into maritime east Asia, or to survive within a highly contested A2AD envelope. However, for those missile systems to be effective, China must have a resilient ocean surveillance capability via satellites, high altitude drones, and ground based sensors. This network between the 'sensor and shooter' is the vital enabler for China's A2AD capabilities.

With that in mind, a requirement for resilient sensor to shooter links will accentuate the importance of gaining and maintaining a speed advantage, in addition to gaining and sustaining a knowledge edge. In the 1991 Persian Gulf War, the multi-national coalition

quickly gained a decisive advantage over Iraq because it had an assured knowledge edge that allowed it to operate well inside the decision cycle – the 'OODA loop' – of the Iraqi military.[30]

In future war, it is not at all certain that US and allied forces would be able to quickly gain and maintain such a knowledge edge, and a protracted, but rapid struggle for digital dominance is likely to emerge. This could initially take the form of a new 'battle for the first salvo' involving decisive military strikes within the space and cyber space domains, and across the electro-magnetic spectrum, as a prelude to or concurrent to military operations in traditional domains of air, sea, and land. This implies the possibility of a modern cult of the offensive, as the side which strikes most decisively and most rapidly, leaves their opponent effectively deaf, dumb, and blind, and unable to regain the battlespace initiative. The loser must then struggle to regain and reconstitute lost capability in space, counter ensuing cyber-offensives and defeat adversary electromagnetic operations. An inability to restore vital C4ISR networks would leave traditional air, sea and naval forces severely degraded in effectiveness, particularly in the face of new threats such as hypersonic weapons.

Autonomous Weapons and swarming

The ADF are moving ahead with experimentation in autonomous systems across all traditional domains of land, sea and air, and are investing in some key capabilities. For example, the Royal Australian Air Force (RAAF) is acquiring the MQ-4C Triton high altitude long-endurance UAV to partner with crewed P-8A Poseidon maritime patrol and response aircraft, as well as the MQ-9B Sky Guardian armed remotely piloted UAV. [31] Defence is also supporting local development of the Loyal Wingman Airpower Teaming System that will provide crewed-autonomous teaming capabilities for armed UAVs alongside crewed combat and combat support platforms such as the F/A-18F, F-35A and E-7A Wedgetail.[32] Australia's Defence Science and Technology (DST) group host regular autonomous technology experimentation events, such as 'Autonomous Warrior' and the 2022 Maritime RobotX Challenge.[33]

With these systems, humans are currently 'in the loop' and have direct control over lethal military systems. Current trends in autonomous systems suggest a transition to being 'on the loop' by giving greater degrees of trusted autonomy to a range of uninhabited and autonomous military systems in the air, at sea on or below the waves, and on land. The constraints of ethical, moral, and legal practices, including Jus in Bello

and international humanitarian law weigh heavily on the minds of military planners considering the application of these capabilities, at least in western liberal democracies. [34] However, it may be the case that adversaries choose to move faster in this transition and are even prepared to go further, potentially considering the benefits of humans fully 'off the loop' through fielding fully autonomous military systems that are directly controlled by AI. The moral, ethical, and legal dilemmas that are so constraining for governments in western liberal democracies may not be as acute for authoritarian states that are answerable only to themselves.

Australia's approach to autonomous systems is highlighted in several concept papers and strategy documents. For example, the Royal Australian Navy's 'Remote Autonomous Systems – Artificial Intelligence 2040' (RAS-AI 2040) strategy explains the RAN's perspective on the introduction of autonomous systems in coming decades.[35] It considers likely technology development in terms of autonomy, interoperability and communications, and secure computing and networking, and then explores the likely maritime missions that could be accomplished now, the potential tasks in the near term out to 2030, and then the possibilities for the far term by 2040.

Similarly, the Royal Australian Air Force 'HACSTRAT' paper seeks to rapidly deliver a path to future air and space capability that is integrated into the joint force. It notes that

> "The force of tomorrow will be characterised by invisible connections across air, land maritime, space information and cyber – with masses of data from sensor inputs fused with artificial intelligence and machine learning – to rapidly convert data to information to knowledge and to insight at unfathomable speeds."[36]

Like Navy's RAS-AI 2040, Air Force's 'HACSTRAT' emphasizes the role of AI to enable autonomous systems to augment crewed aircraft and human activity. It notes that crewed platforms will be force multiplied using robotic and autonomous systems, which enable increased mass, and exploit miniaturisation. It suggests a growing preponderance of 'remotely or autonomously piloted' systems as well as the use of hypersonics to 'help us reach further faster', and notes that 'space will become increasingly pivotal.'[37] Most importantly, HACSTRAT challenges traditional approaches to capability design in a way that is deliberately disruptive and designed to 'jolt Air Force out of its comfort zone.' As quoted in the HACSTRAT document, Air Commodore Philip Gordon, former DG Air and Space, states "…if we 'status quo' our way to the future we will fail."[38]

The Australian Army too has an approach to robotic and autonomous systems,

outlined in its 2018 Robotic and Autonomous Systems Strategy, and more recently within the 2020 Joint Concept for Robotic and Autonomous Systems.[39] The latter document highlights that robotic and autonomous systems

> "…provides Defence the opportunity to achieve greater combat power within its planned budget by increasing its physical and non-physical mass. It challenges an assumption that Australia cannot achieve mass compared to regional competitors as RAS offer the potential for Defence to increase the scale of effect that can be employed within planned resources."[40]

This is a key feature associated with development of advanced autonomous systems, that are either controlled directly by an AI on board an uninhabited platform, or from a command-and-control network incorporating AI. The possibility of a return of mass to the battlespace, in which 'quantity has a quality of its own' represents an important shift away from reliance on ever smaller numbers of ever more complex and expensive crewed systems, in the air, at sea and on land. Swarming in warfare, involving large numbers of loitering munitions, and low-cost armed drones suggests a future warfare scenario in which these systems attack legacy platforms in large numbers, overwhelming their defensive systems, and challenging their continued relevance and efficacy. This has already been glimpsed in the recent conflict between Azerbaijan and Armenia in 2020, in which Azerbaijan employed large numbers of drones to devastate Armenian ground forces.[41] In future war it is likely that swarming as a tactic, employing low cost 'kamikaze drones' and 'loitering munitions' of the sort employed in the Azerbaijan-Armenia war, would be widespread. This is not constrained to the land, but in an Indo-pacific context, could equally be applied to air and maritime environments. Development of extra-large unmanned underwater vehicles (XLUUVs) such as the US Navy Orca system opens the possibility of fully autonomous UUVs operating independently of crewed submarines and naval surface combatants, with the lower cost of such platforms allowing a greater number of systems, thus expanding the quantitative strength of naval forces.[42]

Rather than modern military technology driving armed forces towards more boutique and brittle force structures composed of fewer numbers of more complex and expensive platforms, the shift from 'platform-centric' paradigms to a 'system of systems' approach, employing networked force structures that include large numbers of autonomous weapons and systems seems to be emerging as a key indicator of the future shape of warfare. This idea is not new. As far back as the early 1990s, Martin C.

Libicki suggested the idea of 'Fire Ant Warfare' in which thousands of networked and autonomous microsensors and microprojectiles would overwhelm legacy systems.[43] The 'small, cheap and many' would overtake the 'large, expensive and few' on the future battlespace, challenging traditional approaches to capability development.

When considered against the broader trends implicit in a fourth industrial revolution (4IR) that incorporates rapid synthetic design and development and additive manufacturing (i.e., '3D Printing') technologies, the transformation in both the future shape of military forces, *and* the potential for disruptive innovation in terms of logistics and sustainment are undeniable. The development of the Loyal Wingman Airpower Teaming system in Australia is indicative of this change, taking only three years to go from a concept on paper to the first flight of the prototype.[44] The faster pace of development and production that is implicit in the use of autonomous systems, together with the prospect of lower cost of acquisition, heralds a period of disruptive innovation in military affairs, in which quantity rather than purely quality emerges as a source of military advantage.

The implications of Hypersonics

The speed advantage mentioned earlier is perhaps most significant in considering the impact of hypersonic weapons, which travel faster than five times the speed of sound (Mach 5 – 6,174km/h). China and Russia, as well as the United States, and others are pursuing a range of hypersonic missile systems.[45] Both China and Russia have operationally deployed hypersonic weapons, with China having deployed the DF-17 Hypersonic Glide Vehicle and has recently flown a hypersonic glide vehicle at global range in two fractional orbital bombardment system (FOBS) tests.[46] It is also testing advanced scramjet engines suitable for hypersonic cruise missiles that could be used in an antiship or land-attack role, and under Project *Tengyun*, is developing a fully reusable two stage to orbit hypersonic spaceplane.[47] This latter effort could transform Chinese space launch capability for rapid and responsive launch to enhance China's space resilience, and conversely, for offensive counterspace operations against US and allied space systems.

Andrew Davies notes that there's a long history of hypersonics research in Australia, dating back to the 1960s, much of it centred within the University of Queensland in cooperation with the Australian Defence Science and Technology group.[48] Australia possesses several hypersonic test facilities, including the Woomera test range, as well as aging but still effective hypersonic wind tunnels. He also notes that the 2020 Force

Structure Plan also included a reference to funding hypersonics research under the Southern Cross Integrated Flight Research Experiment (SCIFiRE).[49] He sums up Australia's potential future hypersonics capabilities, stating

> "Given Australia's in-country capability in hypersonics, there's an opportunity here for a rapid integration of newly developed hypersonic weapons into the force structure. The Defence Strategic Update notes that Australia's 'plans also include the acquisition of advanced air-to-air and strike capabilities with improved range, speed and survivability, potentially including hypersonic weapons… Australia isn't likely to want to acquire a global strike capability, but we're likely to be in the market for tactical hypersonic weapons to improve our strike capability, including anti-shipping weapons."[50]

The development of hypersonic weapons would certainly be in collaboration with the United States, emerging from SCIFiRE, with US efforts spread across several key projects.[51] The urgency to deploy hypersonic weapons, to match Chinese and Russian capabilities is likely to grow, given the potential impact such weapons will have on the future battlespace.

Hypersonic weapons compress decision time and extend tactical reach of missile capabilities. They demand early detection and tracking, ideally from space-based sensors, if terrestrial forces, such as naval vessels, are to have any chance of intercepting such weapons. The sheer speed of hypersonic weapons means that relying on local sensors would give virtually no time to intercept an incoming hypersonic weapon, rendering traditional forces such as aircraft carrier battlegroups highly vulnerable to attack.

There is debate over just how transformational hypersonic weapons will be in future warfare. The Chinese tests of their FOBS-HGV capability in late July and mid-August 2021, generated intense debate between those who argued that such a capability could potentially be seen as close to a 'Sputnik moment' against those who dismissed the significance of the capability.[52] The latter saw analysts citing the predominance of traditional ballistic missiles as a more effective delivery capability, and even challenging that the test was in fact an actual FOBS capability.[53] Advocates for the argument that hypersonic weapons will be transformational point to the weapons short time of flight that compresses a timeline for response, and its unpredictable flight path, evading ballistic missile defence systems. That short time of flight is of key importance given the potential for loss of political control over military forces, especially in an operational environment

that is also seeing intense counterspace, cyber and electromagnetic operations, and such a scenario raises the possibility of miscalculation leading to unintended escalation, especially if it is uncertain as to whether an incoming hypersonic weapon is carrying a nuclear or conventional warhead.

The US Missile Defense Review of 2019 highlights the critical role that space-based missile early warning and tracking play in countering hypersonic threats, such as air-breathing scramjet powered cruise missiles, as well as HGVs of the type recently tested by China in a FOBS profile.[54] In depending increasingly on space-based missile early warning and tracking which sits hundreds of kilometres above the visual or radar horizon, terrestrial missile defence systems have a better chance of detecting an incoming hypersonic threat, tracking it, and facilitating an interception of a missile. If the potential addition of directed-energy weapons (DEW) such as solid-state lasers are integrated, the combination of space-based missile early warning, missile interceptor systems, and DEW allows the best chance of defeating hypersonic threats. The risk facing such an effort is that adversary counterspace capabilities can be applied against these satellites to 'pluck out the eyes' of missile defence networks and cripple the ability of terrestrial forces to counter hypersonic threats. In effect, this increases the likelihood that space is not just an operational domain, but is a warfighting domain, from the outset of a future military conflict.

The Importance of the Space and Cyberspace Domains in future war

The examination of emerging themes of future warfare above – the importance of autonomous systems, the challenge of faster operational tempo for command and control, notions of swarming, and the role of hypersonics represent some of the most prominent aspects of debate on the character and conduct of future warfare. In addition to this capability-orientated analysis, the role of new operational domains, particularly space as an operational and warfighting domain, as well as cyberspace to attack critical information infrastructure, must be considered. There is also a blurring of these two domains, as the possibility of cyber attack on satellites and satellite ground stations emerges as a key challenge for space security.

Australia's elevation of space as an operational domain in the 2020 Force Structure Plan is a huge step forward in thinking compared to past white papers, which at best mentioned space briefly as an enabling environment for terrestrial forces, almost as if an afterthought, or worst, failed to address the importance of space at all. The shift parallels

a broader change in Australian thinking on space, both in terms of defence and national security, as well as civil and commercial aspects, that reflects a shift away from previous passive dependency on other states and commercial actors to provide a 'space segment' whilst Australia contributed a 'suitable piece of real estate' for ground facilities, towards becoming an active provider of sovereign space capability. The establishment of the Australian Space Agency in 2018, and the ADF Space Command from 2022 reinforces that Australia is now adopting a more sophisticated and ambitious perspective on space, including local development of space capabilities. With the growth of a commercial space sector, Australia is perhaps a year or two away from having the ability to launch Australian satellites on Australian launch vehicles from Australian launch sites on a regular basis.

For defence, this gives Australia the opportunity to enhance ADF capabilities in space, through key projects such as advanced satellite communications (Project JP-9102), sovereign geo-intelligence and earth observation (DEF-799 Phase 2), as well as space domain awareness (JP-9360), but also resilient positioning, navigation, and timing in a contested space domain (JP-9380), and most recently, a ground-based space electronic warfare capability (JP-9358).[55] This is a far cry from passive dependency and reflects a determination by Australia, and the growth of space capability, particularly emerging from an on-going space domain review to be finalised in 2022 is set to continue. The establishment of a sovereign launch capability in Australia is a key step, that will enable Australia to play a vital role in ensuring resilient space capabilities, both for the ADF and for key allies.

Space resilience is seen as vital given the contested nature of the space domain.[56] Australia can no longer assume assured access to vital space support in future war which will likely see increasing threats from adversary counterspace capabilities, and offensive use of ASATs.[57] Russia's recent test of a kinetic-kill ASAT reinforces the likelihood that in spite of the best of intentions on the part of international diplomatic and legal efforts, major powers will deploy counterspace capabilities, including a range of soft-kill systems, both space based and ground based, that are more usable than kinetic ASAT systems which leave clouds of space debris as an enduring challenge. The ground-based 'soft kill' systems include the prospect of cyber attack on satellites and on the ground segment, which could generate scalable and reversible effects via third-party non-state actors, offering an aggressor a degree of anonymity and deniability.

In future war, it is the combination of a rapid offensive counterspace campaign, directed against an opponent's vital space support systems – known as a 'space pearl harbour' – together with the offensive employment of cyber attacks on critical

information infrastructure – that are likely to represents the first shots of that war. Such measures also lend themselves to the prospect of grey zone operations, both in space and in cyberspace, at a level below that which would quickly justify a military response.[58] This use of grey zone operations allows offensive actions to occur even in peacetime, with Australia recently under cyber-attack from Chinese hackers launching cyber-attacks against Australia's Parliament.[59]

The increasing dependency on space and cyberspace for undertaking joint and integrated operations in the future battlespace will only accelerate the ADF's move towards deploying resilient space capabilities, and potentially even transitioning from a Defence Space Command towards an eventual Royal Australian Space Force in the more distant future, whilst the growth of Australia's offensive and defensive cyber capabilities is certain to continue.

Implications for the ADF in the Indo Pacific

In considering these themes of future warfare, and Australia's approach to addressing new military capabilities, its vital that the ADF, together with the Australian Defence organisation embrace new approaches not only to military operations but also capability acquisition. There is a risk that continued primacy of large, expensive platforms could erode our ability for innovative use of new types of technology, at the same time, starving the capability acquisition process of funding, skilled personnel, and political support for new capabilities. The greatest risk lies with autonomous systems, with a more cautious incremental approach to development of a range of advanced systems in the air, at sea and on land, hostage to legacy capabilities. In an operational sense, the risk is that of Libicki's 'Fire Ant Warfare' in which Australian ships, aircraft and ground forces are overwhelmed by adversary swarms of autonomous capabilities, many of which are directed not by humans on the loop, but through AI's making swifter tactical decisions than humans could possibly make. The ability of an adversary to strike rapidly at great range, using hypersonic weapons or advanced precision strike missiles, means that access to forward bases is at risk. That highlights the dangers of over-dependence on short-range crewed platforms, such as the F-35A Joint Strike Fighter, that now forms the core air combat capability for the RAAF. Lack of range confers an operational advantage to an adversary in a race to the swift – the side which strikes first, gains a decisive advantage. In future war in the Indo-pacific, this battle of the first salvo, be it in traditional domains, or in space and cyberspace, could well be decisive in shaping the outcome of conflict.

Australia's defence planners and strategic policy community are very aware of these challenges, and are seeking to address them, but face a serious challenge in changing ossified thinking within the Defence organisation on capability acquisition and overturning traditional paradigms regarding defence policy. The disconnect between the worsening strategic outlook facing Australia, against the outdated but still persistent 'steady as she goes' approach to capability acquisition is a serious risk to Australia's ability to meet future challenges that will occur in this decade and beyond. Australia makes a fine contribution to discussion about future warfare and future weapons, but many of its defence policy processes remain attuned to the last war. Addressing this policy gap and rapidly implementing new approaches to capability development and acquisition must be the most urgent priority for meeting future challenges. As noted above, the publication of strategy papers and concepts is not found lacking in Australia's defence policy community, and the defence organisation is very aware of the significance of new types of emerging military capability and new operational domains. Implementation of efforts to incorporate these new approaches to warfare is patchy in both organisational acceptance, and the pace of change. The risk posed by worsening US-China tensions, particularly over the possibility of a dangerous crisis across the Taiwan Straits perhaps in the second half of this decade means that Australia needs to accept change and recognise the importance of moving rapidly towards acquiring and deploying new types of military capabilities within the Indo-Pacific region.

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