An Australian Intellectual Edge for Conflict and Competition in the 21st Century

Major General Mick Ryan
The Centre of Gravity series

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(E) Andrew.Carr@anu.edu.au
(M) 0421 728 207

Assistant Editor
MacCallum Johnson
(E) maccallum.johnson@anu.edu.au

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About the author

Major General Mick Ryan graduated from the Royal Military College, Duntroon, in 1989 as a Combat Engineer. Early career highlights include: serving with the 6RAR Battalion Group in East Timor in 2000; in 2003, being the lead planner for development of the first ADF Network Centric Warfare Roadmap; and in 2005, serving as the Deputy J3 for the Multi-National Security Transition Command – Iraq, Baghdad. Major General Ryan commanded the 1st Combat Engineer Regiment from 2006 until 2007, and commanded the 1st Reconstruction Task Force in southern Afghanistan from August 2006 to April 2007.

Major General Ryan has held multiple strategy-related appointments. He has worked in Military Strategy Branch, Military Strategic Commitments Division, as a strategist on the United States Joint Staff, and as Director General Strategic Plans for Army. From October 2014 until February 2016, Major General Ryan commanded the Darwin-based 1st Brigade. From February 2016 until October 2017, he led the education, training and doctrine efforts in Army as Director General Training and Doctrine. During this, he authored and implemented the Ryan Review, a fundamental and future-oriented strategic review of Army’s approach to education, training, doctrine and lessons learned.

Major General Ryan has a Bachelor’s degree in Asian Studies from the University of New England and is a graduate of the Australian Defence Force School of Languages. He is a Distinguished Graduate of the United States Marine Corps Command and Staff College, and a graduate of the USMC School of Advanced Warfighting. In 2012, he graduated with distinction from the Johns Hopkins University, School of Advanced International Studies, earning a Masters in International Public Policy.

Major General Ryan has deep experience in the fields of strategy, interagency and joint operations, command and leadership as well as professional military education. He possesses a long-standing interest in national and military strategy, military history, as well as organisational innovation and adaptation. He was appointed Commander, Australian Defence College in January 2018.
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Major General Mick Ryan

Executive Summary

- The Australian Defence Force and broader national security community face a capability gap. – Not for equipment but in achieving and maintaining an ‘intellectual edge’.
- The intellectual edge, manifest in individuals and institutions, will be critical for maintaining western military prowess in a future where Australia’s military capabilities will often be smaller than adversaries and only occasionally technologically dominant.
- The convergence of information and biological technologies may radically reshape education, particularly in the Professional Military Education sphere.
- The ‘strategy’ for building the intellectual edge contains three components: institutional, educational and technological. At the intersection of these three areas lies an adaptive, continuous and accessible future approach.

Policy Recommendations

- Defence should adopt ‘the intellectual edge’ as a policy goal in the next Defence White Paper and develop a strategic vision that defines and resources its required outcomes out to 2030.
- Capability development in Defence be evolved to recognise military education as a key military capability.
- Expand Defence’s current level of research and development, and innovation funding, for new methods of learning, enhanced human-machine teaming education and ways to expand the accessibility of military education.
- Build capacity to re-educate and re-skill Defence personnel more rapidly to account for accelerating technological change.
- Defence should continue to enhance accessibility of military education to service deployed, remote personnel and organisations.
- Continue to enhance the quality of Defence’s partnering with Australian universities for the purpose of a broad education for military personnel.
- Enhance Defence collaboration with allies on sharing information on best-practice military education.

We now live in the Cognitive Age.¹

Over the past decade, Australian academics and policy makers have been forced to readjust their thinking about Australia and how it might secure its interests in a changing world.² The re-emergence of China as a powerful player in Australia’s region, as well as the developing strategic competition between the United States and China have driven a reassessment in national security and defence policies. Michael Wesley has recently written that ‘the challenges of defending Australia will become much harder in the twenty-first century. Finding a way to protect our way of life and values on this indefensible continent will be the hardest security challenge we’ve ever confronted’.³
Adding to the complexities of national security planners, this ‘contested world’, is potentially now at the start of a new industrial revolution. The revolution is underpinned by connectivity, biotechnology and silicon-based technologies that includes artificial intelligence. Described as the 4th Industrial Revolution, it is disrupting business, entertainment, communications, transportation, and national economies. Like previous industrial revolutions, it is almost certain that this one will also change how societies across the globe develop and interact.

These transformations will inevitably result in changes to how Australian governments evaluate national security. As Kenneth Payne recently noted, ‘For encultured humans, technology, warfare and society are dynamically linked’. This means that the change driven by this new industrial revolution globally will cascade into how Australia views its defence policy and the capabilities of the Australian Defence Force (ADF). While this will have many implications, an important aspect must be a transformation in the intellectual preparation of military leaders to adapt to, and excel in, this changed geopolitical and technological era.

In his excellent book on military innovation, Dima Adamsky describes how a military institution needs ‘to figure out the tools of war (hardware) and anticipate their application (software). The task with regard to software will be much more demanding and a cultural approach will be indispensable for it’. This domain of ‘military software’ – concepts, innovative structures and processes; and, the intellectual preparation of military leaders – is seldom debated outside small communities of interest. The majority of debates about defending Australia and its interests revolve around national defence policy and then immediately leap to a focus on equipment, and sometimes, structures. This is entirely reasonable. However, it results in a capability gap for the ADF that is difficult to perceive from the outside but critical in preparing for and conducting military operations. This gap, which I describe as a military software gap, can result in a failure of imagination, a failure to anticipate and a failure to learn and adapt. It is a gap that has caused military failure and catastrophe from antiquity through to modern times.

I describe the challenge as addressing a military software gap, but this is not solely a military problem. It is incumbent on the entire national security community to ensure it is investing in those institutional programs which build the intellectual edge in their people and also in their organisations. Indeed, this must be a whole of Government, and whole of nation approach. The possession of a national security community that is honing its intellectual edge at different speeds creates gaps; gaps that competitors and adversaries can exploit.

A transformation in the intellectual preparation of military leaders to adapt to, and excel in this changed geopolitical and technological era.
The aim of this paper is to provide insights into how Defence might apply its knowledge of this changing environment to addressing this software gap. The insights in this paper are designed to inform and strengthen Defence’s ongoing efforts to reform professional development of its people. These insights should also assist the broader national security establishment to anticipate their organisation learning and education requirements, lest Australia join the long queue of nations and military institutions whose failure to anticipate change has seen them suffer catastrophe. While the focus of this paper is on developing Australia’s future military personnel, concurrent and complementary development of civilian national security professionals is also necessary.

National Security and Education: An Evolved Intellectual Edge

Over the coming decades, most Western militaries including Australia’s will be smaller than potential adversaries. Compounding this challenge, the ADF will fight in a new hyper-technical and increasingly disaggregated physical-cyber operating environment. Increasingly dominated by more lethal weapon systems and the manifestations of a convergence of info and biotechnologies, the future conflict space will largely be a technologically level playing field. As recent publications such as the 2018 United States National Defense Strategy Commission have described, the technological edge that has been the preserve of Western military institutions for several centuries has declined. And where nations such as Australia can generate capability advantages, these are likely to be transient rather than enduring. The Australian military – and broader national security establishment – must evolve another type of advantage. Lacking this technological edge, and without recourse to mass, the only other option is that this advantage be an intellectual edge.

This intellectual edge manifests in two different, but interconnected, ways. The first is individual professional mastery. The intellectual edge for an individual is the capacity for that person to be able to creatively out-think and out-plan potential adversaries. It is founded on the broadest array of training, education and experience that can be provided by institutions, as well as a personal dedication to continuous self-learning over a long period of time. Increasingly, this intellectual edge for an individual will be underpinned by cognitive support through human-artificial intelligence teaming. Described as ‘System 3’ thinking by Dr Frank Hoffman, this still nascent field in the collaborative application of biological and machine intelligence will increasingly be core to the development of the intellectual edge in military personnel.

The second manifestation of the intellectual edge is institutional. While the intellectual edge in single leaders and planners is vitally important, so too is a collective, institution-wide intellectual edge. This comprises an organisation’s capacity to effectively harness the disparate and diverse intellects of its individuals to solve complex institutional problems in the short, medium and long term. This institutional intellectual edge must be applied to the challenges of force design, operational concepts, integration of kinetic and non-kinetic activities and personnel development and talent management.

If this evolved approach is to thrive, the best within this culture, the elite military thinkers, must be celebrated and nurtured. This might be similar to how Australians currently celebrate and value elite sportspeople. Defence must offer incentives to encourage elite thinking, and potentially, promotion pathways and talent management systems adapted.

The acme of prowess in achieving national security outcomes in the 21st century will be achieved by those military and other national security institutions that are able to harness their personnel in a way that nurtures and celebrates in them the intellectual edge, while applying this in a unified way to institutional challenges. Further, it is unlikely that human-only software will suffice. Increasingly, synthetic biology and artificial intelligence must be used in concert with human intellectual power to general this advantage. The ultimate expression of this institutional intellectual edge will be the capacity to either win without fighting in a strategic competition, or, ensuring that it is able to apply its strengths to win any fight that it must engage in. In order to build this intellectual edge Defence must appreciate three additional elements of context that will influence the development for this new edge.
The first is the profession of arms and its provenance. Understanding the history of an institution provides a steady foundation for exploring potential future trajectories. It also provides an understanding of the core or enduring functions of military professionals. As Michael Howard writes, ‘warfare is one of the very few human activities that is clearly defined over time with distinct criteria for success and failure. Upon this knowledge has grown the profession of arms, which can make judgements about the past to draw conclusions which have an abiding value’.

The second influence is continuity in the wider security environment. Regardless of the disruption caused by various elements of the future environment, there are likely to be some enduring characteristics of the future environment. One continuity is that it is likely that humans will still wage war on each other. Another is that nation states will continue to seek to defend their interests and sovereignty. It is important to understand these because they provide the context against which future military officers are prepared. The ADF can apply this knowledge to balance their investment in the intellectual development required to address change in the environment with that required for enduring skills and knowledge.

A third and final influence is likely to be the profound impact of the convergence of information and biological technologies. For millennia, military leaders have applied their intellects and the artefacts of war to achieve their desired ends. Regardless of the age however, these military leaders have used machines and other tools as one part of their overall approach to win battles, campaigns and wars. The world is now at the precipice of an era where humans and machines will work in an largely symbiotic way. The rapidly evolving capabilities of artificial intelligence holds the promise of supporting better decision-making by military leaders and their political masters. For the first time in human history, humans and machines may be truly equal partners in many of the cognitive aspects of war and strategic competition. These trends provide the ADF, as well as the wider national security community, with context for the development of the intellectual edge.

Developing the Future Intellectual Edge: A Design

Military personnel must be able to expand their skills and concentrate on the intellectual capacity to apply themselves to a wide array of activities which they may not have been prepared for. This requires a whole of enterprise approach to applying the right level of resourcing and is focused on producing people that are ready for contemporary and future challenges, applying the military art and science within a broader national security establishment. The design for how this system operates within a larger
military enterprise however must be driven by strategy. This strategy should draw its desired goals from the capability objectives of the Australian military and wider national security establishment for the next two decades. This ‘strategy’ for building the intellectual edge contains three components: the institutional, the educational and the technological. At the intersection of these three areas lies an adaptive, continuous and accessible future approach to intellectual development in Defence.

I. Institutional Imperatives.

A Strategic Vision. The development of military personnel, through education, training, experience, talent management and other mechanisms, provides the essential ‘software’ of a military institution.\textsuperscript{15} Therefore, an institutionally endorsed view of future military personnel – especially their leaders – is required. This should form part of a more expansive view of future military capability and national security policy. Recent Defence White Papers have largely avoided this issue and not provided a strategic rationale or vision for military education. The 2016 Defence White Paper contained two sentences on joint professional military education in a 188-page document.\textsuperscript{16} These two sentences lacked context and were not linked to any desired output of education. In comparison, the 1976\textsuperscript{17} and 1994\textsuperscript{18} versions contained more substantial coverage. This should be addressed in future White Papers, with education and training recognised as a core capability alongside those such as land combat, cyber operations and maritime strike.

Strategic Engagement. Engagement between like-minded military institutions – between Services and between like-minded nations – must continue to evolve and embrace a greater sharing of ideas. There is a wide array of ideas in military education being shared online, but this is not always replicated between institutions. Enhanced sharing – of best-practice curricula, of outstanding academic personnel, new learning approaches, and new military theories – must be one of the cornerstones of the future approach to Western military alliances.

Strategic engagement must however extend beyond the sharing and exchange activities of like-minded institutions. Engagement with civilian universities is critical. In these civilian institutions resides hundreds of years of learning across the humanities and sciences. Civilian universities represent a resource that can provide intellectual rigour to further hone military personnel at the undergraduate and post graduate levels. They also provide viewpoints on national security that might differ from officially sanctioned policy, forcing military students to more carefully analyse the shibboleths of contemporary national security policy.

Educational Institutions as Think Tanks. The ADF should not see its professional educational institutions as pure learning for individuals, air-gapped from the remainder of the organisation. High calibre military and civilian personnel are selected to attend courses like the Australian Command Staff College course, and Defence and Strategic Studies Course, at the new Australian War College.\textsuperscript{19} Given their talent, the large network of a diverse range of officers, and their access to high quality academic advisors, there is a potentially expanded role for these student bodies in thinking about responses to the strategic challenges that are disrupting national security establishments.

II. Educational Initiatives.

Continuous Learning. Murray and Millet, in their examination of inter-war military innovation, found that military leaders were better able to lead and invest in innovative new ideas and technologies when they had undertaken continuous learning throughout their careers.\textsuperscript{20} The future ADF requires a continuum with functional descriptions of what their people must be capable of at various stages of their professional journey. It should not however be an industrial age production line. The continuum is...
a ‘backbone’ around which individually tailored intellectual development might be constructed, avoiding long temporal gaps in professional development activities. This holistic approach to continuous learning may also have the added benefit of assisting in identifying and fostering talent and refining career management systems of the ADF.

**Skill, Re-Skill, Repeat.** The future environment is one where the construction and destruction of occupations and industries will occur more quickly than in previous industrial revolutions. As Yuval Noah Harari has recently predicted, ‘…just as in the 20th century governments established massive education systems for young people, in the 21st century they will need to establish massive re-education systems for adults’. Therefore, Defence will need to possess a system that is built around skilling and rapid re-skilling their personnel as technology and strategic circumstances change. Entire generations of military leaders may have to be re-educated over the next 5-10 years because of the profound impact of these new technologies, and the historically unprecedented acceleration in technological change.

**Guided Self-Development.** Formal education cannot cover all the needs in the intellectual development of contemporary or future Australian military personnel. Therefore, formal education must be supplemented through self-study by individuals. This self-study might be most effective if it is complementary to formal educational experiences. The implication of this is that military organisations should provide curated resources that military personnel can ‘pull down’ from their institution – using internet or other sources – to supplement their formal development. As the explosion in number of military themed blogs, and self-study sites such as The Cove and The Forge attest, there is a significant appetite in today’s junior officers for self-discovery and learning to complement and supplement more formal military educational experiences. These curated hubs of professional development material may be changed quickly to adapt to changes in the strategic environment or in technological developments. They might therefore comprise a resource that has a shorter adaptation cycle than military schools and academies.

**Technological Literacy.** A range of advanced technologies, such as hyper-sonics, space-based capability, information technologies, and biotechnology are starting to proliferate through military organisations. But if institutions are to effectively use these systems, they will need informed users. Military organisations will therefore need more than just deep technical experts in the development of algorithms and the design of artificial intelligence for military systems. As a recent U.K. Government report describes, skilled workforces using new technologies should be a mix of those with a basic understanding, more informed users, and specialists with advanced skills. Over the coming years, at almost every rank level, military personnel will require basic literacy in a spectrum of new and disruptive technologies. This must include knowledge of its application, how to provide a level of assurance and quality control, and how to optimally combine them with new concepts and human organisations at every level.
Most Western military education systems generally do not provide this enhanced literacy for all their personnel. However, it is the coupling of technical experts with a heightened technological literacy across the entire force that will allow future military organisations to fully exploit the benefits of artificial intelligence. Existing professional military education programs must be adapted, as the Australian Defence College recently undertook, to deliver this higher standard of technical literacy. Adding another strand to extant curricula focused on technological literacy, the ethics of advanced technology, and their procurement and logistics will create a wider institutional capacity to understand new technologies, absorb them into military inventories and develop the new operating concepts and strategies to use them effectively (and wisely).

**Futures, Education and Adaptation.** The curriculum of military institutions must be informed by an institutional view about the future environments its people will operate within. Military education must form closer and more substantial linkages with organisations – in the military and beyond – that undertake futures work. There should be a transparent and logical pathway, shaped by informed views of future needs, to prepare for the intellectual development that will be required by military personnel in the future.

To retain relevance and remain at the forefront of best practice, the ADF’s educational system should also complement its future work with mechanisms for adaptation. The profession of arms needs to remain at the forefront of understanding best practice in education and training. The system requires formal mechanisms to identify the need for change, to make informed decisions about change and to enact those changes in a timely and efficient way.

**III. Technological Initiatives**

**Accessibility.** Much of contemporary military education and individual training is delivered in a residential setting. While this provides for good learning outcomes, it results in only a small percentage of military personnel gaining access to joint learning opportunities. The use of a joint-force educational continuum will provide a framework to guide the development of a larger eco-system of more available educational opportunities.

Defence must continue to break down geographic, technical and cultural barriers to create a truly connected force where education is continuous and self-sustaining. There is much the ADF can learn in this area from the civilian education sector, while also leveraging efforts such as the United States Department of Defense Advanced Distributed Learning Initiative.

**Innovation in Engagement and Delivery.** The pace of change in technology is accelerating. While this has impacted wider society, it is also disrupting long-standing approaches to training and education. Technology has enabled a more ‘connected’ approach to learning, particularly the use of blogs, curated self-study sites, online learning and Massive Open Online Courses, and video conferencing. This is resulting in a gap between older (or heritage) institutional education models and the newer digitally-enabled approaches.
Defence can partner with the organisations undertaking technical research in this area. A key organisation will be the Defence Science and Technology Group. It could undertake research into new learning methods and enhanced accessibility. Importantly, this key Defence asset might provide informed access to other institutions undertaking best-practice educational research and assist to remain at the forefront of technological understanding.

More recent digital age technologies offer even more advanced approaches to learning. Artificial intelligence has the potential to significantly change the way militaries educate their personnel. In combining knowledge and expertise of teaching, knowledge of subjects being taught and knowledge of learners, AI may underpin an expanded range of potential activities to support the learning of military personnel. Artificial intelligence could provide Intelligent Tutoring Systems for individuals or provide a better-informed learning partner that accompanies and assists the learning of the military personnel throughout their careers.

Augmented Cognition. While the potential for the augmentation of human cognition may still seem like science fiction, breakthroughs in information technology and synthetic biology hold out the prospect for augmenting human cognitive functions in the long term. Fundamentally, augmented cognition seeks to circumvent human limitations by building environments where it is easier for humans to encode, store and retrieve information presented to them. The field of augmented cognition incorporates topics such as adaptive learning systems, brain-computer interfaces, crowd-augmented cognition, cognitive load and performance, and neurotechnology. All of these areas are still relatively immature. However, one promising area for early examination is complementary computing.

A recent report from the United States National Academy of Sciences highlighted how complementary computing – leveraging the strengths of humans and computers for optimal completion of tasks – may enhance decision-making and human productivity. While there is potential for human-robotic interaction, the long-term potential of this approach extends to how humans learn in collaboration with machines and then how they might operate in a symbiotic way to better understand their environment and make better decisions.
Further into the future, the potential for neurotechnology to improve human cognitive functions is being explored by the United States Defense Advanced Research Projects Agency. In a project called the Next-Generation Nonsurgical Neurotechnology program, scientists are seeking to build a neural interface that can read and write to multiple points in the brain at once. Technological developments such as this holds promise for significantly enhanced human-computer interaction in the future.\(^{36}\)

Coupled with advances in information technology, such as machine learning, big data and artificial intelligence, this closer connectivity between humans and computers to improve cognition may significantly change how the ADF is able to develop leaders capable of working in human-AI teams to develop more effective future strategies and warfighting concepts.

Multiple obstacles to effective augmented cognition remain.\(^{37}\) Despite this, a range of different approaches to augmenting human cognition are likely to become available in the coming decades. The impact of these technologies on learning and developing future military leaders is worthy of exploration in the short term and might be an area of collaboration across Western military institutions. Designing these developments into the ADF’s education and development capabilities should commence soon if the ADF is to remain at the forefront of the exploitation of these advanced technologies.

### A Performance Based Approach

The ADF recently endorsed a performance-based approach including a new joint professional military education curriculum and a new continuum that describes five stages of an individual’s intellectual journey.\(^{38}\) These five stages provide a useful baseline for assessing future needs. While work on this has commenced, much remains to be done. Changes in the global environment continue to accelerate, and human skill-sets for the future are almost certainly going to be influenced, evolved or augmented through artificial intelligence, synthetic biology or a convergence of the two. This must be a highly adaptive performance-based approach to ensure it retains relevance for the ADF.

Each stage of this future performance-based approach must describe the performance capabilities of Australia’s future military leaders. They must be additive – each stage provides the foundation for subsequent growth and development of the officer. This progression through the various stages is designed – with experience, interaction with others, training and education – to build the cognitive abilities that underpin critical and creative thinking in planning and the exercise of command. It comprises an essential backbone for professional growth and evolution, and represents the manifestation of Moskos’ institutional core, providing a unifying approach for generalists and specialists.\(^{39}\)

### TABLE The Continuum for Developing Future Military Leaders

<table>
<thead>
<tr>
<th>Training and Years</th>
<th>Years 5-10 in commission</th>
<th>Years 10-15 in commission</th>
<th>Years 15-25 in commission</th>
<th>Years 25 onwards in commission</th>
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<tr>
<td>Professional Foundations</td>
<td>Developing Tactical Mastery</td>
<td>Operational Artist</td>
<td>Nascent Strategist</td>
<td>National Security Leader</td>
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This multi-stage journey is complicated in peace time by what Williamson Murray describes as the ‘privileging of certainty and low-risk behaviour, instead of preparing themselves widely and deeply for the uncertain, high-risk endeavour that is war’.\(^{40}\) Continuous learning also represents a significant undertaking for the ADF and demands ongoing investment in facilities, staff, time and other resources.
Conclusion

The global security environment has fundamentally changed. Australia and its security establishment, including the ADF, must prepare for future threats that the application of technology and mass will not solve. Where nations such as Australia can generate capability advantages, these are likely to be transient and less enduring than in previous eras. Only by addressing the military software gap – through better thinking, adapting quickly and building the intellectual edge – will Australia possess an improved capacity for securing future national interests and retaining a full measure of national sovereignty. While many of the skills required may change, and the human composition of the ADF will continue to evolve, the intellectual preparation of military people for the demands of future conflict and strategic competition is an enduring requirement.

The paper provides insights into how the ADF might address the challenges of overcoming a military software gap. These insights should be useful beyond Defence. The whole national security community can draw lessons for investing in the intellectual edge of its people. While the paper has focussed primarily on the ADF, simultaneous and complementary development of civilian national security professionals is also essential.

At heart, this is a paper that seeks to respond to contemporary and future security challenges and to tell the story of how the Australian military institution can succeed – in peace and war – if it rededicates itself to building an enhanced intellectual edge. With individual and institutional manifestations, this is a central tenet of military capability in an era of geopolitical competition, societal change and an accelerating pace of technological disruption.

Policy Recommendations

- Defence should adopt ‘the intellectual edge’ as a policy goal in the next Defence White Paper and develop a strategic vision that defines and resources its required outcomes out to 2030.
- Capability development in Defence be evolved to recognise military education as a key military capability.
- Expand Defence’s current level of research and development, and innovation funding, for new methods of learning, enhanced human-machine teaming education and ways to expand the accessibility of military education.
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- Defence should continue to enhance accessibility of military education to service deployed, remote personnel and organisations.
- Continue to enhance the quality of Defence’s partnering with Australian universities for the purpose of a broad education for military personnel.
- Enhance Defence collaboration with allies on sharing information on best-practice military education.
Endnotes


10 This is brilliantly examined in Morris, I., Why the West Rules for Now: The Patterns of History, and What They Reveal About the Future, Farrar, Straus and Giroux, New York, 2010.

11 The term transient advantage is used in a 2013 article on competitive strategy, in McGrath, R., ‘Transient Advantage’, Harvard Business Review, June 2013. It is also a concept used in presentations by the Royal Australian Air Force as part of their Plan Jericho reform.


19 The new Australian War College was established in January 2019.


23 The Cove is an Australian Army initiative, launched in December 2016 to provide a curated, unclassified hub of professional material that engages learners outside of the work environment. https://www.cove.org.au/.

24 The Forge is an Australian Defence College initiative that supports continuous learning in key areas of the Continuum of Joint Professional Military Educations for officers and interested national security stakeholders.


26 This must include knowledge of its application, how to provide a level of assurance and quality control, and how to optimally combine it with new concepts and human organisations at every level. Ryan, M., ‘Intellectual Preparation for Future War: How Artificial Intelligence Will Change Professional Military Education’, War on the Rocks, 3 July 2018.

27 Approaches to achieving this are explored in Ryan, M., Human Machine Teaming for Future Ground Forces, Centre for Strategic and Budgetary Analysis, Washington DC, 25 April 2018.


29 The new Australian approach, described in The Australian JPME Continuum, was endorsed by the Chiefs of Staff Committee in the Department of Defence in 2018.

30 This expanded access must include online education as well as unit-based professional military education activities. The theme of broadened access was a key theme in Australian Army, Australian Army PME strategy, October 2017, p. 6.


38 This five-stage approach was endorsed in July 2018 by the Australian Chief of Defence Force as part of the development of a new Joint Professional Military Education continuum in the Australian Defence Force. https://theforge.defence.gov.au/publications/joint-professional-military-education-jpme


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