Chief of Navy Essay Writing Competition

Essay Topic: "With reference to any historical example, what are the implications for the future of the Royal Australian Navy?"

Undersea disruption: retaining a potent covert capability

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Undersea disruption: retaining a potent covert capability

Introduction

As the Royal Australian Navy (RAN) begins the process of acquiring a new generation of submarines, it is important that ample discussion be given to the usefulness of this platform and the challenges it faces. Submarines are an integral part of the RAN and rapid development of Anti-Access and Area Denial (A2AD) technologies will make this increasingly so. Advances in Unmanned Underwater Vehicle (UUV) and Autonomous Underwater Vehicle (AUV) technologies are generating both opportunities and challenges that will increasingly affect submarine operations going forward. In this essay we will discuss the historical salience of Australia's submarine capability, address the propulsion and technological challenges faced by contemporary submarines, and draw out the implications for the RAN. This will include recommendations for 'future proofing' the *Attack*-class submarine – a contentious subject that has stimulated vigorous debate in Australia. There is legitimate concern that by the time this platform is in the water it will already be obsolete. To avoid this, Defence must be agile in its response to technological advancements.

Australia's Covert Cold War Submarine Operations in East Asia

On the 20th February 1986, Prime Minister Bob Hawke received a historically significant briefing - integral in securing political support for the replacement of the ageing *Oberon*-class submarine.[1] Commander Kim Pitt had been invited by Defence Minister Kim Beazley to recount to Hawke what the RAN's *Oberon*-class submarines were capable of, by illustrating the achievements of a patrol that had been conducted aboard HMAS *Orion* the previous year.[2] The patrol focused on Cam Ranh Bay on the east coast of Vietnam - the largest Soviet naval base outside of the United Soviet Socialist Republics (USSR).[3] Hawke was shown clear footage, taken through HMAS *Orion's* periscope, of a surfaced Soviet *Charlie*-class nuclear submarine heading into Cam Ranh Bay.[4] The footage captured sonar and other fittings mounted along the hull; highly valuable information given one of the only other ways to obtain that intelligence was for a western spy to penetrate dry-docks in the Soviet Union – a difficult and dangerous task.[5] This information, along with other intelligence cooperation activities, significantly amplified Australia's contribution to the Cold War intelligence collection game - increasing Australia's value as an alliance partner.[6]

Between 1977 and 1992 about 20 covert patrols were conducted, allowing Australian submarines to produce vital intelligence and assist in the effort to track and identify the Soviet fleet.[7] On another mission, HMAS *Orion* tracked a Soviet *Kirov*-class nuclear-powered cruiser entering Cam Ranh Bay, and was able to use its communications lines to record the cruiser's procedures and protocols upon arrival in Vietnam.[8] This was vital information, furthering Western understanding of Soviet naval communications and command and control (C2) systems.[9] These outcomes were used to justify the purchase of 6 *Collins*-class

submarines to replace the *Oberon*-class – a vital naval asset to Australia's national security.[10]

The history of Australia's covert submarine patrols during the Cold War indicates the vital importance of submarines as an asset in the inventory of the RAN. The unique and highly valuable intelligence dividends generated by the *Oberon*-class clearly demonstrate the importance of maintaining an effective submarine capability. Submarines are highly versatile vessels, and in addition to serving as an intelligence-gathering platform, they also greatly enhance the fighting potential of the wider Australian Defence Force (ADF) - granting Australia a maritime deterrence platform.[11] Information, Surveillance, and Reconnaissance (ISR) missions like those undertaken by HMAS *Orion* are extremely relevant to Australia's contemporary strategic environment. As regional tensions increase and countries throughout the Indo-Pacific undertake efforts to modernise their military capabilities, the Australian Government may increasingly find itself needing to conduct covert missions in order to gain intelligence and maintain strong situational awareness within the region.

A2AD Proliferation: The Increasing Importance of Submarines

The Indo-Pacific strategic environment is changing rapidly as the focal point of international tensions return to Australia's region.[12] As a result, Australia is facing its most challenging maritime security environment since World War II.[13] Strategic affairs in the Indo-Pacific region will increasingly be determined by the major Asian powers themselves, and much of this will depend on their relationship with one another. Australia cannot afford to trust that this will always be a peaceful process. Just as the *Oberon*-class submarines provided Australia with an invaluable capability to engage as a significant player during the Cold War, Australia's *Attack*-class future submarines will be extremely important.

In light of changing regional dynamics, the Australian government must carefully consider the platforms it seeks to invest in. Although a power rebalance in the Indo-Pacific is undoubtedly taking place, the US is likely to remain a strong force in the region for many decades.[14] However, if, sometime in the future, ANZUS ceases to be the reliable security guarantee for Australia that it has been since 1951, the ADF may need to be able to provide its own fully independent deterrence force.[15] In a region that is undergoing significant military modernisation and build-up of capabilities, Australia cannot afford to lag behind. Thus, the Australian government has decided to dedicate substantial funds to the *Hunter*-class Future Frigate, *Hobart*-class Air Warfare Destroyer (AWD) and the French-designed Shortfin Barracuda *Attack*-class Submarine.[16]

Problematically for Australia, investment in A2AD capabilities across the Indo-Pacific will result in the enhanced vulnerability of surface platforms like Frigates and Destroyers.[17] Andrew Davies, senior fellow at the Australian Strategic Policy Institute (ASPI), has argued that large, slow and expensive surface vessel "have little future in the 21st century".[18] The AWD (alongside the Future Frigate)

carries the Australian-made 'Nulka' missile decoy system, Anti-Ship Missile Defence upgrade (SEA 1448), SM-2 missiles and even more capable SM-6 missiles - coordinated by the Aegis Combat System.[19] However, these platforms are still at risk of being overwhelmed by anti-ship missiles.[20] As the cost of these missiles is a fraction of the cost of the surface platforms they target, a high missile-loss tolerance is acceptable.[21] All it takes is one successful hit and the RAN will have lost a vessel worth approximately $2 billion dollars to a missile worth around 1,600 times less.[22]*

China's newly improved variant of the DF-21D Anti-Ship Ballistic Missile, as well as the recently commissioned DF-26 intermediate range ballistic missile (IRBM) - China's most advanced IRBM - are prime examples of accelerated A2AD development in the Indo-Pacific.[23] The DF-26 in particular with its 4,000 km range will have a significant deterrence effect.[24] While the deterrence value of these missiles is consequential, developments in supersonic and hypersonic missile technology will further threaten the survivability of surface vessels in the future.[25] The Chinese military has also recently revealed the CM-401 Close Range Ballistic Missile (CRBM), which according to associated graphics has 'porpoising' or 'skip-glide' trajectory - giving it the potential ability to dodge missile defence systems.[26] With an estimated top speed of Mach 6 the CM-401 is a new breed of supersonic anti-ship missile.[27] Although it has been designated as a CRBM with an acknowledged range of 290 kilometres, there is some debate about whether the Chinese are hiding its true range, which could be as great as 1,000 nautical miles.[28] This missile could also be fitted to Type 055 *Renhai*-class destroyers, enhancing its utility and expanding China's A2AD network.[29]

The AWD, alongside Australia's Future Frigate, is slated to be equipped with Raytheon's 'Cooperative Engagement Capability' (CEC) system, a key enabler of the U.S. Navy's Naval 'Integrated Fire Control-Counter Air' (NIFC-CA) capability.[30] This 'sensor-netting system' provides a state-of-the-art networked 'battle' picture and, in combination with the Aegis Combat System and its AN/SPY 1D(V) phased array radar, plus SM-2 and SM-6 missiles, will make both the AWD and Future Frigate formidable platforms.[31] While this technology mix will make these platforms highly capable - developments in missile technologies like the CM-401, with its supersonic (and eventually hypersonic) speed and manoeuvrability, will continue to threaten the survivability, and thus high-end war-fighting utility, of surface vessels.[32] Because of this limitation, the AWD and Future Frigates' most vital high-end war-fighting role will be to work in an interoperable manner with other assets like submarines, which are not vulnerable to the same types of land based cruise and ballistic missiles as surface vessels are.[33] In light of these developments and the increased vulnerability of surface vessels, submarines will remain an essential part of the RAN's force, potentially becoming even more important than they were during the Cold War.

By 2030, half of the world's submarines will be concentrated within our region.[34] Although this is unsurprising it remains strategically significant nonetheless. In April 2019, Indonesia launched its third *Nagapasa*-class submarine, with contracts signed for five more and a stated aspiration for ten.[35] Meanwhile, late last year Japan launched its first *Soryu*-class diesel-electric submarine featuring

lithium-ion batteries, with more to come.[36] South Korea is also pursuing lithium-ion powered boats with its second batch of KSS-III attack submarines adopting the technology.[37] This has led submarine historian Derek Woolner and renewable technology commentator David Gylnne Jones to argue that in a little over a decade East Asian nations will have acquired highly capable submarines, thanks to improvement in lithium-ion battery technology.[38] Given these developments, Australia must have a highly capable submarine fleet of its own.[39]

A Contentious Debate: Propulsion

The Australian Government's decision to acquire 12 new submarines to replace the *Collins*-class, triggered significant public debate about the proposed design of Australia's future submarine. The RAN will be expected to operate in the same area of operations as nuclear submarines from at least four other countries.[40] However, because the *Attack*-class Future Submarine will be a conventionally powered diesel-electric submarine, its nuclear-powered peers in the Indo Pacific region will outmatch it for speed and endurance.[41] This fact, combined with changing strategic circumstances throughout the region, has led politicians, strategists and defence experts to question whether the government should be looking to acquire nuclear powered submarines.[42]

Because nuclear powered submarines can essentially operate for as long as the crew has food and water, they would indeed enable the RAN to better transit across, and thus more easily cover, its extensive operating area.[43] However, Australia's lack of existing nuclear infrastructure, combined with public opposition to developing the sort of indigenous nuclear industry required, means that the nuclear submarine option is both practically and politically unpalatable.[44] Australia's saving grace may actually come in the form of advanced battery technology.

Developments in battery technology will increasingly mean conventionally powered diesel-electric submarines become more effective, as advanced batteries will allow for lower indiscretion rates.[45] By 2050, battery technology could be advanced enough to allow for conventional submarines to go on fully submerged missions for up to 60-80 days.[46] Combined with Air Independent Propulsion (AIP), the endurance of the submarines could be extended even further, providing a highly capable platform.[47] Battery technology development will also further enable renewable energy power generation, and alongside increasingly improving battery storage capacity, means it is unlikely Australia will ever need to develop a nuclear industry for energy purposes.[48] Taken together, these factors negate the need for Australia to continue to flirt with politically unpalatable, prohibitively expensive and logistically fraught nuclear propulsion. As many independent experts have already approved aspects of the *Attack*-class program and design, doing a 180-degree turn towards nuclear propulsion for the future submarine would be a fruitless exercise and spell doom for an already risky venture.[49]

Challenge: Increasing Detection Capabilities

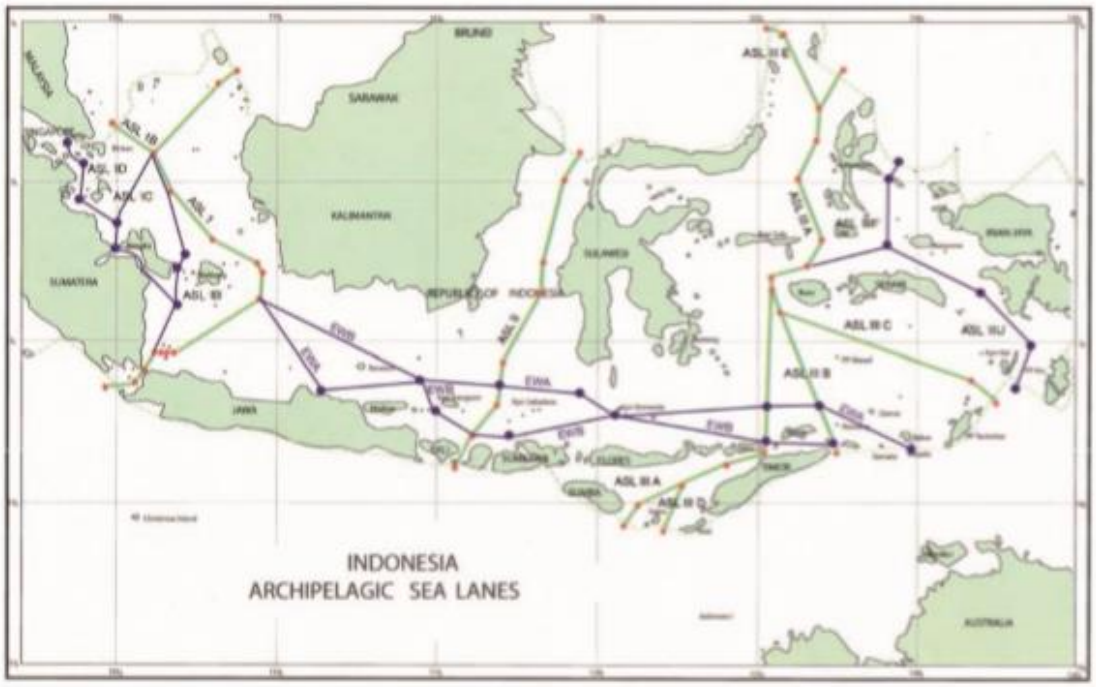
Although submarines will undoubtedly remain a potent platform going forward, technological developments will increasingly make it difficult for submarines to operate freely.[50] Anti-Submarine Warfare (ASW) sensor and detection technologies are improving rapidly, namely due to advances in 'big data' analytics.[51] The result is that there now exists the capacity to process and compute the data required for exploiting these new detection techniques.[52] Developments in Unmanned Underwater Vehicles (UUVs) - relatively small, remote or semi-autonomous – and larger Autonomous Underwater Vehicles (AUVs) (included into the UUV category unless directly highlighted), as well as Autonomous Surface Vessel (ASV) technologies, are also set to threaten submarines by improving detection capabilities.[53] 'Wave Gliders', small autonomous systems that draw energy from the world around them, also pose a unique challenge. Capable of traveling vast distances, these ASVs can be configured to monitor the environment around them, listening for submersibles over an extended period of time.[54] Set up in an array, these platforms provide actors with the potential to screen a given area, greatly enhancing the situational awareness of a force.

ASVs carrying advanced sensors will likely increase the distance at which manned submarines must operate. Such technologies may threaten the ability of submarines to conduct 'brown water' operations such as Close Target Reconnaissance (CTR) - like that done by Commander Pitt in HMAS *Orion*, inserting special forces or positioning near an adversaries' coast line to launch a tactical land strike.[55] However, just as the development of new technologies poses a challenge to the operation of submarines, these same technologies also provide a range of opportunities. The adoption of unmanned systems provides a lower-risk solution for the continued conduct of covert operations.

Opportunity: UUVs

With future developments in A2AD potentially restricting large submarines to 'blue water' operations, the RAN must find a way to maintain its ability to conduct ISR. Integration of UUVs into the force may provide a solution. Around the world UUV technologies have been developing rapidly, with autonomous and semi-autonomous systems being utilised to complete a range of tasks. Many of these technologies are dual use, capable of serving in both civilian and military roles. Key examples of this are Kongsberg's AUV *Remus 100*, of which the RAN has several, and Lockheed Martin's *Marlin* AUV.[56] The *Remus 100* is capable of undertaking intricate sonar and oceanographic surveys over large areas, with uses ranging from pipeline surveying and environmental assessments to mine countermeasure operations and surveillance.[57] The *Marlin* is designed to complete subsea infrastructure surveys and inspections, and carries 3D imaging sonar, cameras and lighting - technologies that can be easily translated across to the military domain.[58] These vehicles could be used to complete tasks like those undertaken by HMAS *Orion* during the Cold War, photographing vessels and monitoring key transit routes and ports.

UUVs can be used to augment the RAN's existing force, enabling it to meet future challenges. The increased number of submarines within our region is problematic for the RAN. No matter how good a vessel is, it cannot be in two places at once. Thus, the RAN will be hard pressed to keep tabs on the movement of submarines throughout the region. There are numerous navigable straits throughout Southeast Asia that funnel seaborn traffic through the archipelago.[59] Whilst this restricts the movement of potential opponents, there remains significant territory for the RAN to cover. Thus, these choke points pose both a challenge and opportunity for the RAN, primarily to its ability to sustain its presence throughout the region.



Major Shipping Routes Through Australia's Northern Approaches.[60]

The RAN faces restrictions in its ability to fund and crew a larger submarine fleet. Substantial debate exists over the ability of the RAN to man the 12 new *Attack*-class submarines. In July 2018, Australia's submarine workforce stood at some 780 people, just enough to maintain the *Collins*-class fleet.[61] Substantial work will have to be done to expand the number of Australia's submariners and support staff if we are to properly crew HMAS *Attack* and the boats that follow. The *Collins*-class is Australia's most expensive platform to sustain, estimated at $566 million (not including capability upgrades) for financial year 2019-2020.[62] In addition to their $4 billion initial purchase price, the *Attack*-class will cost substantially more to sustain due to the increased number of boats and their relative complexity.[63] It is here that autonomous systems provide a solution. Integration of AUVs to supplement Australia's submarine fleet can provide a cost-effective way of expanding the presence and efficiency of the RAN without the need to find highly skilled crews.

Both the United States Navy (USN) and Royal Navy (RN) are adopting large AUVs. This presents Australia with the opportunity to further integrate itself with both navies by jointly developing autonomous and semi-autonomous capabilities and operating procedures.[64] The USN has ordered five 'Orca' variants of Boeing's *Echo Voyager*.[65] Fully autonomous and capable of independently launching smaller UUVs, the 'Orca' could greatly enhance the RAN's surveillance capabilities. Able to operate for months at a time using a hybrid rechargeable power source, a similar platform would enable the RAN to chart a course and send the AUV on its way, leaving it to do key ISR tasks such as monitoring straits - thus freeing up manned submarines.[66] The integration of larger AUVs would also enable the RAN to expand its force, getting greater coverage for less money and reducing its sensitivity to losses. As highlighted by Marcus Hellyer, ASPI's Senior Analyst in defence economics, UUVs can compensate for the weaknesses of manned platforms and, being designed to complete a specific task, do it cheaper.[67] With this in mind, UUVs offer a range of opportunities for altering the ways the RAN undertakes operations.

Uses of UUV Technology on the Battlefield

UUVs have a range of uses, many of which will be highly valuable to the combined efforts of the ADF. As identified earlier, developments in A2AD technologies are creating a 'maritime no mans land' that will impose severe costs on any that try to cross it.[68] Thus, submersibles will become even more integral to the conduct of ISR and pre-landing operations. However, with detection capabilities continuing to advance, the risks of lingering off an enemy port, like HMAS *Orion* at Cam Ranh Bay, will rise to perhaps unacceptable levels. The type of tasks that need to be conducted for these operations have not changed, however, the way they are undertaken must. UUVs provide a potential solution. The ability to send a small UUV into contested or unfamiliar waters instead of a traditional manned platform allows for the conduct of dangerous operations, without imposing additional risk onto Australia's service personnel. The development of UUVs equipped with magnetic and ground penetrating radar, sonar and recording equipment provide ways of completing a variety of ISR and pre-landing operations. These vehicles can be used to explore beaches, ports and waterways, hunting for mines and other obstructions, mapping reefs and coastlines and collecting imagery, unseen by observers and greatly enhancing the situational awareness of the RAN and wider ADF. However, whilst having the ability to bring clarity, UUVs can also add significant uncertainty to the battlespace.

UUVs will enhance the complexity of the modern battlespace. Driven by their size, relative autonomy, and potential for operating in high-risk areas, UUVs, in combination with other autonomous systems like unmanned aerial vehicles (UAV), will be used to create entropy on the battlefield.[69] Just as technologies like armoured vehicles and aeroplanes began as vulnerable, poorly integrated, and often unreliable tools of war, autonomous and semi-autonomous systems, whilst novel, are developing rapidly. Over a span of three decades, between the First and Second World Wars, armoured vehicles and aeroplanes had developed into

highly capable fighting machines, greatly changing the nature of the modern battlefield.[70] There is little reason to believe that this will not be the case with autonomous systems. Used to mine ports, lie in wait for convoys, or act as mobile sensors, UUVs will enable actors to target a force's key vulnerabilities – supply ships, naval infrastructure, propulsion systems on vessels – and generate uncertainty around operations. Not knowing where UUVs may be located or what actions it may be undertaking, will force actors to be extremely cautious - adding another dynamic to the battlefield.

UUV-Submarine Integration

The best way for the RAN to ensure the strategic utility of submarines into the future is to build vessels with the capacity to launch UUVs. Despite progress in A2AD technology, submarines will remain relevant to Australia's force posture. Being hard to detect will always be preferable. Of the RAN's existing craft, submarines remain the most survivable. However, whilst A2AD developments do not make them obsolete, they do alter the way submarines might go about completing their missions. As highlighted above, UUVs provide the perfect capability for operating in high-risk environments. Thus, manned submarines can be used as a form of 'mothership' – posturing offshore to launch UUVs and UAVs to conduct surveillance and detection missions, while maintaining their traditional A2AD role.[71] The French are already doing this with their nuclear powered *Barracuda*-Class variant and, thus, Australia should look to leverage the relationship to access this capability.[72]

Australia's *Attack*-class submarine must be designed to be able to launch multiple UUVs.[73] Like the proposed role of the loyal wingman, deploying forward of the F35, which plays a systems of systems coordination role, submarine launched UVs will enable the more vulnerable and valuable *Attack*-class to remain further afield.[74] The ability to use submarines as 'mothersubs' allows for the covert deployment of specialised UUVs. Without the need to travel extended distances, the size of UUVs can be kept to a minimum, enhancing their ability to avoid detection. Eventually AUV technology may develop to the point where they can operate from forward bases, much like current submarines, instead of being launched by 'mothersubs'.[75] However, Australia's *Attack*-class submarine should still be designed and built with the ability to launch UUVs - as a contingency that ensures they have the best chance of remaining relevant in the face of fast technological advancements. To future proof the RAN, and assist it to be a potent regional Navy going forward, the Department of Defence must integrate UUVs into Australia's submarine fleet.

Conclusion

The RAN's future submarine must have the ability to launch and recover UUVs. As A2AD weapons develop, the value of submarines increases. As the world turns to watch developments in the Indo-Pacific, it is essential that Australia has the capability to protect its interests and maintain an edge over its neighbours. Just as HMAS *Orion* and the remainder of the RAN's *Oberon*-class fleet were key instruments in ensuring Australia was capable and aware of developments within our region, the new *Attack*-class must be able to meet our future strategic environment and needs. Developing technologies like autonomous systems and lithium-ion batteries will change the way Navies around the world go about conducting operations. Although the development of highly sophisticated AUVs - capable of launching from ports in Australia and independently traveling to their destination - proficient enough to fully replace manned submarines is still a way off, UUV technology cannot be ignored. Semi-autonomous UUV technology is advancing rapidly and Australia's next generation of manned submarines must have the capacity to act as a 'mothersub'; launching and recovering semi-autonomous and eventually fully autonomous UUVs. This will greatly enhance the RAN's ability to work around A2AD systems, minimising the risk to its crews and facilitating the continued conduct of 'brown water' ISR operations.

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