Artificial Intelligence and Its Implications on Future Submarine Warfare

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

This essay will discuss artificial intelligence (AI) and its effect on developing unmanned systems, as well as their potential to implicate future submarine operations (SUBOPS) in the Royal Australian Navy (RAN). This essay will reveal the historical findings and developments of AI, the current use of unnamed systems within the Australian Defence Force (ADF), note the advancements of AI, detail the requirements for further maturing and the advantages that may potentially be obtained through the use of AI during programmed SUBOPS by the RAN. This discussion will be concentrating on the below water domain and its operations.

AI has tended to be viewed as new age, however, it was in the 1950's when computing first came into being where the concept was originally explored. Alan Turing[1], a man who explored the unknown, was a computing pioneer and AI theorist. He was the first to question "can machines think?" and in doing so, suggested the idea to create a test called 'The Imitation Game'. This is now known to be the 'Turing Test' and was created to pinpoint if machines did in fact have the intelligence that was in question. This test entailed a combination of a person and a computer, with an interrogator asking a series of questions to decipher which of the two contestants was the person and which was the machine. Turing's overarching notion has been a profound influence into the advancement of AI. Simple examples of AI being used would be popular apps like Siri and Google Now.

Today's AI advancement is incredible, with the ability to collect and organise large amounts of information, detect irregular patterns and make decisions autonomously beyond human capabilities. The research into AI and its maturing has made it easier for people and businesses to perform faster and accurately. On a bigger scale, AI has played a crucial role into enhancing surveillance and reconnaissance, unmanned underwater systems (UUV's) are prime examples. These systems have been proven to enhance capability and provide convenience, either for commercial purposes (e.g. hydrography and oceanographic research), or for Defence capability as this technology has had substantial growth in military power and their assets.

The ADF already employs unmanned automated systems. The RAN in particular employ three, these are the *'Double Eagle MK.11*[2]*'*, a mine disposal underwater system, a '*Scan Eagle'*[3] used for operational evaluations, as well as the '*S-100 Camcopter*[4]*'*, carrying multiple payloads with an operational window of six hours at a time. These systems play a crucial role in achieving Australia's maritime goals. The use and continual development of AI enhances the RAN's ability to provide its capability for the government and allows the ADF to push past the normality's of warfare whilst adding versatility to military assets. The future of the RAN will be implicated by the research of AI, more so in the unmanned realm.

[1] (Professor Noel Sharkey, Alan Turin: The experiment that shaped artificial intelligence, 21 Jun 12) Website: https://www.bbc.com/news/technology-18475646
[2] NAVY Website: http://www.navy.gov.au/unmanned-systems/double-eagle-mk-ii
[3] NAVY Website: http://www.navy.gov.au/unmanned-systems/scaneagle
[4] NAVY Website: http://www.navy.gov.au/aircraft/s-100-camcopter

The RAN's transition from Collins class submarines to diesel-electric Short Finn Barracudas is said to be the largest, most complex project in defence history[5]. This transition will have a total lead time of 16 to 30 years and already is significant milestone in the submarine domain, however, relative to peer competitors, we are behind. Russia's unveiling of the world's first nuclear-armed unmanned submarine, 'Poseidon'[6], as well as United States building four unmanned submarines to be known as 'Orca'[7], demonstrates that the future of underwater development is heading towards greater heights than ever predicted. It's evident that UUV's will be deployed in the near future for combat operations and, will add to the complexity of the maritime environment and battle space. The advancements of AI will alter future of submarine warfare and the way SUBOPS will be conducted.

UUV's currently, are seen in the role of remotely piloted tasks, that of which attract deep and hazardous operations (e.g. mine hunting)[8]. With the developments of AI and remote automation, their role is evolving to more offensive patterns. These systems are more or less disposable and can operate in dangerous waters whilst also mitigating risks that traditionals attract. For example, the United States newly contracted 'Orca' could pretend to be a full size submarine, waiting for enemy submarines to take a shot while their manned 'Virginia Class' nuclear powered attack submarine sits back, waiting to ambush[9]. The Orca could take on dangerous missions that traditional submarines couldn't, and perform in higher risk operations to track enemy submarines and gather intelligence on their opponents. UUVs will implicate the standard operation procedures of traditional submarines and their stealth abilities.

Traditional submarines have had a strong impact on naval capability and will continue to be a strategic asset, however, the future of submarine warfare is falling into the advancement of sensors and their ability to detect[10]. The rapid development of AI and automation renders current and future underwater weapons at higher risk of detection. A key objective would be to develop submarines and systems that can operate and update at a faster capacity and in the most cost efficient manner, as this will be vital to the naval domain. The challenges posed by continuous advancement of weaponry, means a decrease of putting forces to work in an offensive operational environment due to higher risks posed by the advancement of sensors (anti-warfare).

Defence will require a larger capacity to defend and deter any potential conflict that may be posed in the future. With the risk of being detected, operations will need to stand further away from these areas. Deterrence may be increased by utilising UUV's in these high risk environments as they can play a crucial role in promoting presence, and maintaining Australia's interests in the SUBOPS domain. With our future submarines operating on a forward an up threat strategy and capability taking on offensive operations, UUV's can enhance these operating abilities and mitigate risk to uniformed members.

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[5] (Marise Payne, France's DCNS to build Australia's Future Submarines, 26 Apr 16) Website: https://www.aspistrategist.org.au/frances-dcns-to-build-australias-future-submarines/

[6] (Sebastien Roblin, Russia Plans to Build Four Submarines Armed with Nuclear Drone-Torpedoes, 29 Jun 19) Website: https://nationalinterest.org/blog/buzz/russia-plans-build-four-submarines-armed-nuclear-drone-torpedoes-64776

[7] (Drew Turney, Orca will change US undersea battle-readiness, 29 Jul 19) Website: https://cosmosmagazine.com/technology/orca-will-change-us-undersea-battle-readiness

[8] (Rosalyn Turner, The unmanned underwater future, 9 Apr 14) Website: https://www.aspistrategist.org.au/the-unmanned-underwater-future/

[9] (Vidi Nene, Boeing Wins Navy Contract for Extra-Large Drone Subs, 15 Jan 19) Website: https://dronebelow.com/2019/02/15/boeing-wins-navy-contract-for-extra-large-drone-subs/

[10] (Lt CMDR Jeff W. Benson, Opinion: A New Era in Anti-Submarine Warfare, 27 Aug 14) Website: https://news.usni.org/2014/08/27/opinion-new-era-anti-submarine-warfare

Maintenance on traditional submarines fall under the 'usage and update cycle' (UUC), this is a long term maintenance plan that is executed after a full 10 year cycle[11]. This work entails a fundamental refit that requires the submarine to be taken out of operation for a two year period, and have the back end of the submarine fully cut-off to enable easier access to the generators and motor. Traditional submarines also require mid-cycle dockings that are usually conducted out of the water, these tend to have a lead time of up to six months. Navy's goal is to sustain our assets and maintain a strong presence in our region. Keeping these goals are crucial, and the strategic possibilities available from unmanned systems allow upgrades to be conducted quicker and faster with a series of plug-in and play modular components.[12], this is a more cost effective outcome in comparison to traditional submarines that attract larger costs and long lead times whilst being refitted.

The future Short Finn Barracuda submarines employee a larger demand on personnel and this effects the higher demand on habitability space on the platform to cater to uniformed members[13]. This space is then compromised by the basic necessities for passengers. Historically the uniformed submarined workforce has tended to fall under limitations and constraints when resolving recruitment and retention[14]. Retention is an essential contributor to both sustaining our current workforce and growing it to the desired level over the next four years and beyond. If these goals aren't met by the required time frames, there is potential that the new future platforms won't reach their full capacity by 2050. The strength of the workforce has been under a microscope, and has had many approaches to resolve these ongoing issues. Defence strategies for submarine workforce growth had been a critical component in achieving its mission to ''fight and win at sea'.

The indicators are that UUV's would not employee similar capacity gaps posed by traditional submarines[8]. Personnel will still need to be acquired, however, not under the same tensions. With the introduction of UUV's in Navy, an additional skilled category could be employed into the submarine force. These systems could improve both availability and capability to our uniformed members. The UUV could deter the workforce pressure of being in an unfavourable environment, and instead allow availability for the workforce to conduct shift work whilst also having the capacity to go home at the end of the day. The investment of these systems could allow the submarine workforce to afford a unique skillset to operate new platforms. These UUV's place substantial effect on the workforce, while still maintaining a presence in our underwater region.

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[11] (Dr Marcus Hellyer, Thinking through submarine transition, Oct 18) Website: https://s3-ap-southeast-2.amazonaws.com/ad-aspi/2018-10/SR%20128%20Thinking%20through%20sub%20transition.pdf?hBI2AIjcgfCmWfgSWQTwaTl5fiQoCgkm

[12] (Edward C. Whitman, BENEATH THE WAVE OF THE FUTURE) Website: https://www.public.navy.mil/subfor/underseawarfaremagazine/Issues/Archives/issue_15/wave.html

[13] (Malcolm Sutton, Winning submarine bidder must meet Australia's 'range and endurance' requirements, 27 Apr 16) Website: https://www.abc.net.au/news/2016-04-26/winning-submarine-bidder-must-meet-australias-endurance/7347034

[14] (Andrew Green, Sailor shortage strands Australian warship HMAS Perth in dry dock for two years, 06 Jun 19) Website: https://www.abc.net.au/news/2019-06-06/hmas-perth-stuck-in-dry-dock-highlights-adf-challenges/11183870

The submarine workforce plays a crucial role in enabling a strong deterrent in our waters as well as maintaining Navy's purpose for submarine capability. Traditional submarines will still be a necessity to Defence and its future operations, although the ability to match traditional submarines with UUVs would enhance the quality and quantity of power in our region. This combination opens new opportunities to further submarine warfare and RAN's assets. The UUV's could provide surveillance and acquire intelligence while the traditional submarines focus on operational tasking to improve their capability in the maritime domain. These systems allow the submarine workforce to enhance their skills and perform at the highest level to provide a strong deterrence in our region. With the combination of both systems, there is a stronger capability to meet future challenges.

These systems still require improvement, with some experts arguing that underwater drone technology is still at an underdeveloped stage. These systems are facing challenges in autonomous operations and communication issues[15]. Due to the density of the water, it's difficult for UUVs to complete complex tasks that require real-time decision-making as data passes very slowly through the water. Their limitations in the ocean will still require substantial strengthening due to them being an untethered system. Improvements into their AI needs further maturity, which is crucial for their future development to adapt to situations intelligently. If these limitations are targeted and developed over time, the need for operators to intervene would no longer be needed, and their tasks can be carried out through autonomous technology. The main need for energy storage, navigation, sensing and control is the main development targeted to enable a strong power under the water. Investing in the continual development of unmanned technologies is an important step towards improving future assets.

To conclude, it's evident that the investment of AI will implicate the future of SUBOPS, UUV's will soon be deployed into combat operations, and add to the complexity of the maritime environment and its battle space. Future RAN operations will be greatly impacted as their challenges will be dictated by the development of AI and its further research into UUV's. However, these drones do have a long way to go. There will need to be research into further maturing, however, AI is and will continue to be a historical gain to defence and will indefinitely implicate the future of submarine warfare, and the Royal Australian Navy.

[15] (Logan Bunting, Challenges of Underwater Communication, 03 Apr 15) Website: https://schmidtocean.org/cruise-log-post/the-many-challenges-of-underwater-communication/

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Short Biography

Born and raised in Perth, completed year 12 in 2015. Enlisted on 11 April 2016 at the age of 18 as a general entry Navy gap year member. Following recruit school, I embarked on a two month posting on board HMAS *Adelaide*. I then posted to HMAS *Cairns* and immersed myself in the Personnel Office, where I elected to follow the path of Maritime Logistics Personnel Operator. My category training conducted at HMAS *Cerberus* awarded me Student of Merit amongst my peers.

Following my training, I posted to Headquarters Joint Operations Command (HQJOC). I now have a unique exposure to a Tri-Service environment. During my time at HQJOC, I was afforded a rare opportunity as a Seaman to conduct a short term replacement as an Executive Assistant to COS NHQ. I have recently been assigned my first posting onto a seagoing platform as an Able Seaman on board HMAS *Adelaide* in June 2020. My longer term ambition is to transfer over and commission as a Human Resources Management Officer.