

# ARTIFICIAL INTELLIGENCE AND ROBOTICS - THEIR IMPACT ON NATIONAL SECURITY

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## ABSTRACT

Artificial Intelligence (AI) has often been described as the next colossus in the military realm, with its capabilities far surpassing that of an ordinary human. In this essay, the author focuses on how AI and Robotics affect the military security for nations like Singapore. He highlights that AI and Robotics will bring about significant benefits, and any new threats will be manageable. The author first begins with a discussion of the key military security vulnerabilities. He then introduces the subject of AI and Robotics, considers the new opportunities they bring, and examines the potential threats that can arise within the military security environment. The author then concludes by deliberating how the character of warfare can change with the extensive adoption of AI and Robotics.

*Keywords: Technology; Artificial Intelligence; Robotics; Military; National Security;*

## INTRODUCTION

In today's Volatile, Uncertain, Complex, and Ambiguous (VUCA) environment, national security goes beyond the traditional notion of military security. Barry Buzan theorised that national security covers economic, societal, military, political and environmental areas, the whole domain and not any single area.<sup>1</sup> Threatening any of these areas can compromise the continued sovereignty and even existence of a nation. For this reason, modern warfare is multi-faceted, and adversaries are more likely to threaten a combination of these security areas as a new form of conflict. An example of this is the hybrid warfare waged by Russia in its annexation of Crimea in 2014, where it targeted various national security areas such as social, political and military.

However, this essay will not cover all the national security areas. Instead, the author will focus on one area—how AI and Robotics affects the military security of nations like Singapore. The author posits that AI and Robotics will bring significant benefits, and new threats will be manageable. In this essay, the author first highlights the key military security vulnerabilities. Second, he introduces the concepts of AI and Robotics, the new opportunities it brings and the potential threats that it can present to the military security environment. The author then rounds off by discussing how the character of warfare can change with the extensive adoption of AI and Robotics.

## MILITARY SECURITY CHALLENGES

Singapore's declining birth rate and lack of strategic depth are key contributors to her military security challenges.

The Singapore Armed Forces (SAF), by 2030, is expected to face a one-third reduction in manpower due to the declining birth rate.<sup>2</sup> As of 2020, the national total fertility rate stood at 1.1, which is significantly lower than the required 2.1 to replace the parents. Concomitantly, there will be lesser male residents in the future for military service.<sup>3</sup>

Singapore does not have strategic depth at just 725 sq km in land size.<sup>4</sup> Neither does she have the geographical barriers that can provide natural military defence. At its nearest point, Singapore is separated from Peninsular Malaysia by just a causeway. During World War Two (WWII) in the Malayan Campaign, the Japanese military overran Singapore from Johor, Peninsular Malaysia, in just seven days.

To overcome the challenges of operating with such constraints, the SAF has been leveraging on technology as a force multiplier. 'Dr Goh and the pioneers conceived this idea 50 years ago... make up for Singapore's lack of manpower, resources and strategic depth using technology.'<sup>5</sup>

## ARTIFICIAL INTELLIGENCE AND ROBOTICS

The arrival of the 4<sup>th</sup> Industrial Revolution (4<sup>th</sup> IR) brought about new technological advancements such as AI and Robotics, the Internet of Things (IoT) and 3D printing.<sup>6</sup> AI and Robotics have been touted as the next

big thing for the military and will play an increasingly prominent role. The United States (US), Russia and China, along with many other nations, have publicly declared their intent to develop and adopt AI and Robotics for their military operations. The US National Defence Strategy identified AI and Robotics as one of the key technologies that will 'ensure it can fight and win future wars.'<sup>7</sup> Russian President, Vladimir Putin publicly declared that 'AI is not only the future of Russia but also the future of all mankind... The one who becomes a leader in this sphere will be the ruler of the world.'<sup>8</sup> China has also released its strategy to be the global leader by 2030.<sup>9</sup>

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## **What is Artificial Intelligence and Robotics ?**

There are no fixed definitions for AI and Robotics as it has been revised over the years, depending on the state of development and who gave the definition. AI can be thought of as a computing system designed to think and act like humans, capable of learning, problem-solving, and decision making.<sup>10</sup> AI will be able to process information, recognise patterns, suggest optimisations, and predict future trends.<sup>11</sup> On the other hand, Robotics are powered machines carrying out human directives, computer instructions or a combination of both.<sup>12</sup> Analogous to a human, AI is the brain, while Robotics are the skeleton and muscles. AI and Robotics can collectively augment or even replace humans to varying degrees of capability, ranging from menial, repetitive tasks, to strategic cognitive level 'thinking'. Driven by computers, AI may process more

data and at greater speeds than humans. As machines, Robotics can function beyond the human psychological limits.

## **IMPACT OF AI AND ROBOTICS ON MILITARY SECURITY**

### **Reducing Manpower Requirements for Military Operations**

Military operations, be it in peacetime or wartime, are manpower intensive. For small nations like Singapore, it can take up a sizeable proportion of the population for example, 2.7%, compared to larger countries such as 0.42%, of the US to sustain the military.<sup>13</sup> This diverts manpower away from other areas of the economy. Coupled with the falling birth rate there may be insufficient people to sustain the military in the near future.

However, many existing tasks are simple, structured, repetitive and low-valued, or dangerous. These tasks are prime candidates to be carried out by AI and Robotics instead of humans. The SAF has been an active proponent of AI and Robotics to enhance the effectiveness and efficiency of military operations, and in the process, reduce manpower requirements. Numerous programmes such as the Republic of Singapore Air Force (RSAF) Smart Airbase and the Republic of Singapore Navy (RSN) Unmanned Surface Vessels (USV) have been initiated to accelerate the use of AI and Robotics.

In the RSAF Smart Airbase programme, AI will help commanders in the Base Command Post sense-make voluminous amounts of data from sensors distributed at various areas and systems, and provide recommendations for follow on actions. AI and Robotics will also be used extensively for aircraft inspection and maintenance, airbase security operations and runway damage assessments and repairs.<sup>14</sup>

The RSN has developed various autonomous USVs for the protection of Singapore waters. An autonomous mine countermeasure USV has been successfully demonstrated, which reduces the number of people required to carry out the operation from 32 (manned version) to just three.<sup>15</sup> A new Maritime Security USV is also being developed with an operating crew of two, compared with the Littoral Mission Vessel's (LMV) team of 23.<sup>16</sup>

## Increasing Operational Capability

The use of AI and Robotics can overcome human psychological limitations. Humans have finite strength and limited load-carrying capabilities. We get fatigued and need to rest and sleep, and this places a limit on our battlefield endurance. Humans are affected by emotions and fears, which interfere with battlefield effectiveness. Humans can get injured or sick, which inadvertently compromises the effectiveness of the whole team. With AI-enabled Robotics, these limitations can be circumvented. The author is not suggesting humanoids like the 'Terminator' to replace humans. This will take some years, not to mention the ethical issues surrounding Lethal Autonomous Weapon System (LAWS). Instead, the author is suggesting Robotics, optimised for specific tasks that surpass human limits. Robotics can transport heavy loads for soldiers, such as the US autonomous Robotic mules that helped carry combat loads of over 1,000 pounds.<sup>17</sup> Israel has also developed a drone that can carry out sniper fire accurately. Not subjected to combat threats, the sniper drone operator can calmly assess the situation.<sup>18</sup> Singapore is also looking at unmanned ground vehicles (UGVs) to augment combat soldiers.<sup>19</sup>

AI and Robotics have the potential to dramatically force-multiply capabilities. Consider a single operator such as a pilot controlling several combat Unmanned Aerial Vehicles (UAV), multiplying its combat power—manned-unmanned teaming. This is precisely what Boeing has developed—the Loyal

Wingman airpower teaming UAV that can work autonomously as a team with existing manned aircraft to extend and multiply combat capabilities. It can be sent ahead of the manned aircraft for Intelligence, Surveillance and Reconnaissance (ISR), tactical early warning, or more dangerous tasks such as suppressing enemy's air defences.<sup>20</sup> The RSN is also developing the next generation's manned-unmanned teaming naval system that will further multiply its capabilities. It will be made up of a single mothership that can simultaneously control multiple UAVs, USVs and Autonomous Underwater Vehicles (AUVs) to extend and expand its capabilities.<sup>21</sup>

Technological developments have brought us closer to the realisation of swarming technologies. The US Navy has completed a test of an AI-enabled swarm of five autonomous boats that co-operatively patrolled and intercepted an 'intruder' vessel.<sup>22</sup> Large groups of UAVs can overwhelm adversaries, defence systems and carry out co-ordinated attacks. The US has successfully tested a swarm of 103 air-dropped micro-drones.<sup>23</sup> China has publicly demonstrated an AI-enabled swarm of 1,180 UAVs as a giant outdoor screen, co-ordinating, synchronising and repairing itself autonomously.<sup>24</sup> For such systems, firepower can easily be scaled up by adding more subsystems, limited only by technology and costs. The system is also significantly more robust as taking out a few drones does not incapacitate the mission.



*BigDog robots trot around in the shadow of an MV-22 Osprey. BigDog is a dynamically stable quadruped robot created in 2005, by Boston Dynamic with Foster Mille, the Jet Propulsion Laboratory, and the Harvard University Concord Field Station.*



## Decoupling of Military Power from Population Size

We have seen multiple examples of AI and Robotics augmenting and replacing humans in various operational tasks. Conceptually, military power can then be decoupled from the population size. Military capabilities and firepower can be 'measured' by the capability of the AI and Robotics system, and not by the military force size. This has a significant advantage for small nations like Singapore, which will be less constrained by dwindling manpower. Then-Permanent Secretary (Defence Development) Ng Chee Khern opined that AI and Robotics could change how the SAF fights, using less manpower but still delivering the same or even more combat power.<sup>25</sup>

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## Reducing Risks to War Fighters

The example of the RSN autonomous mine countermeasure USV highlighted a significant advantage in employing AI and Robotics in military operations—reducing and even eliminating risks of

human casualties. In this implementation, the operators are located onshore, away from the dangerous task of neutralising mines. The recent Indonesian Navy submarine KRI Nanggala 402, which sank with 53 submariners on board, further illustrated the dangers of military operations. Human casualties might have been avoided if the manned submarine was replaced with AUVs.<sup>26</sup> Unmanned Combat Aerial Vehicles (UCAVs) such as the US predators is another example of AI and Robotics use that eliminates risks to its operators.

## Enhancing Situational Awareness and Preparedness with Improved Intelligence

*"New sensing and data analysis tools allow us to achieve near comprehensive awareness. We can protect our borders better, seek out and detect potential threats before they develop into actual attacks."*

*– Senior Minister Teo Chee Hean<sup>27</sup>*

AI and Robotics can significantly improve the quality of intelligence information to pre-empt and prepare against threats. Autonomous systems can provide persistent surveillance and collection of intelligence data in the physical and cyber domains, with minimal human intervention. Given the enormous volume of data available today (e.g., news, social media,



*The Indonesian submarine KRI Nanggala (402) participates in a photo exercise in the Java Sea during Cooperation Afloat Readiness and Training (CARAT) Indonesia 2015.*

videos from drones), manually analysing all the data is humanly impossible or takes too long for the intelligence to be useful, especially against real-time threats. On the other hand, AI systems can autonomously process, sort, correlate large volumes of data from different sources, geographic locations and over extended periods to identify patterns, 'connect the dots', detect anomalies and highlight concerns. The system can do this round the clock, all year round, with little to no human supervision.<sup>28</sup> To illustrate, the SAF had successfully used AI to prevent an Islamic State of Iraq and Syria (ISIS) supporter from entering the country. AI had been used to sense anomalous ship activities and, in 2015, successfully detect a suspected ISIS supporter on board a tanker, who was then denied entry to Singapore.<sup>29</sup> Such applications can easily be extended to other surveillance capabilities to seek out and detect potential threats.

## Increasing Risks of Asymmetric Threats Below the Threshold of War

The dual-use nature of AI and Robotics technology and products (e.g., Da Jiang Innovation (DJI) drones, facial recognition software, cyber hacking software) makes them readily available to the public.<sup>30</sup> Less well-funded states, rogue non-state actors and terrorists can easily acquire and exploit them for malicious use. These products can be adapted into an asymmetric weapon, attaining disproportionate firepower and capabilities.<sup>31</sup>

*"Even low technology could be used in disruptive ways, especially when combined with imagination."*

– Mr Peter Ho<sup>32</sup>

For example, an off-the-shelf drone such as the DJI could be used for ISR. It could also be modified into a low-cost precision weapon by arming them with an explosive charge. AI may be used to enhance the capabilities of cyber-attacks. 'Deepfake' capabilities can be easily acquired and used for disinformation campaigns.<sup>33</sup> The use of these commercial 'weapons' may make it harder to attribute the attacks to any state. This lower barrier of entry may embolden non-state actors and terrorists to be less hesitant to start a low-intensity conflict below the threshold of war, such as

the cyberwar waged by the 'Anonymous' group against Israel in response to the Israel-Hamas conflict in 2012 and the commercial drones sent into Israel by Palestinian resistance factions in the Gaza Strip.<sup>34</sup>

However, these incidents are unlikely to cause significant damages to well-funded and technologically advanced militaries, beyond inconveniences and minor disruptions. The relative military power will still favour them with large funds committed to further advancing military capabilities and countering such threats. For example, Singapore's Defence Science Organisation (DSO) has indigenously developed a Counter-UAV system to detect and neutralise errant drones autonomously. These systems can be used to protect critical installations.<sup>35</sup>

## Increasing Risks of Conflicts

AI are often 'black boxes' to users, who do not understand how the system processes, analyses and decides.<sup>36</sup> Users will find it challenging to definitively know if the system was performing correctly or making the wrong decisions, especially in the VUCA war environment, with many variables and possible considerations. AI and Robotics can accelerate the pace of combat beyond human ability to understand and control, causing task saturation and reducing cognitive capacity and capability.<sup>37</sup> If the AI system erroneously assesses a situation and presents a bigger threat than it is, users may not know. A lack of understanding can lead users to accept analysis and proposals put forth by the AI without further considerations, increasing the risk of errors escalating the conflict.<sup>38</sup> In an autonomous weapon system such as Israel's loitering munition Harpy, there are also risks of unintended engagement of targets other than what was desired and unintentionally escalating a crisis.<sup>39</sup>

During the Cuban Missile Crisis, US leaders had pre-decided that they would attack if the Soviets shot down the U-2 reconnaissance plane. However, after the aircraft was shot down, they changed their minds, suspecting that the attack had not been authorised by Khrushchev.<sup>40</sup> Had AI and Robotics primarily driven the situation, it would probably not have the cognitive ability to change its mind. The most likely course of action would have been to retaliate and this could have led to a nuclear war.



## EFFECTS OF AI AND ROBOTICS ON THE WAY NATIONS SUCH AS SINGAPORE WILL FIGHT ITS WARS

The introduction of AI and Robotics is expected to accelerate the change to the character of warfare—one fought with fewer humans and more AI and Robotics. It will pit algorithm against algorithm, machines against machines. The balance of power will tilt towards the side that can better exploit AI and Robotics to force multiply their warfighting capabilities such as intelligence, sense-making and firepower. Strategies and battle plans may be made by AI, refined and optimised through numerous rounds of war-gaming to maximise the chance of victory.<sup>41</sup> Complex joint operations can become more efficiently and effectively driven by AI. In the VUCA environment of conflicts, the speed at which AI can observe, orientate, decide and act will give it a decisive edge against adversaries.

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The widespread use of Robotics can diminish the human cost of military engagement and embolden militaries to fight harder and bolder.<sup>42</sup> A fear of casualties is a significant concern for commanders and have led to less effective strategies to minimise risk. In the 2006 Lebanon war, Israel opted for standoff attacks against Hezbollah (which proved ineffective) for fear that a ground campaign would result in heavy troop casualties.<sup>43</sup> In another example, during the Kosovo war, North Atlantic Treaty Organisation (NATO) pilots were instructed to fly above 15,000 feet to protect themselves against ground adversaries' fires. However, this limited the pilot's ability to identify targets clearly.<sup>44</sup> These fears could be mitigated if the high risk tasks were replaced by Robotics. The DOGO Robot, an armed tactical combat Robot developed by Israel, can supplement soldiers in urban warfare, sent ahead to survey high-risk areas such as rooms and take out adversaries if required.<sup>45</sup> Open battlefields may be dominated by unmanned combat vehicles, such as the Ripsaw M5 Robotic Combat Vehicle (RCV).<sup>46</sup> Swarms of UCAVs or loitering munitions can fly over battlefields in place of manned fighters. The seas will be patrolled and protected by unmanned vessels such as those currently being developed and deployed by the RSN.



*Howe and Howe Technologies/Textron System Ripsaw M5.*

## CONCLUSION

In this essay, the author has highlighted that the lack of manpower and strategic depth for small nations like Singapore are key challenges to her military security. The incorporation of AI and Robotics in military operations has brought significant opportunities that can alleviate the vulnerabilities, such as reducing the manpower requirements through automation. Operational capabilities are significantly increased through the force-multiplying effects of robotics overcoming human psychological limits, manned-unmanned teaming, and AI-enabled swarming

operations. Other notable benefits include reducing risks by replacing warfighters with robotics, and enhancing overall situational awareness and preparedness with improved intelligence. The author has also highlighted that although AI and Robotics can increase the risks of asymmetric threats, these are manageable. The relative military power will still favour the well-funded and technologically advanced nations. On this note, the author reiterates his position that AI and robotics will bring significant benefits to small nations like Singapore, and new threats will be manageable.

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