The Effect of Artificial Intelligence in terms of Effectiveness and Efficiency on Military Operation

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Article Info

Abstract: This research explores the impact of implementing artificial intelligence (AI) on the effective-ness and efficiency of military operations. With rapid technological advancements, AI has be-come a crucial component in the modernization of military strategy and tactics. This research describes the impact of artificial intelligence on military operations in terms of effectiveness and efficiency. The methodology is descriptive qualitative research on how AI affects military operations and how it compares before the influence of AI. The results show that AI can signif-icantly improve operational effectiveness by increasing intelligence accuracy and tactical re-sponsiveness, as well as efficiency by reducing operational costs and increasing decision-making speed. However, the research also identified associated challenges and risks, such as cybersecurity concerns and the ethics of using AI in armed conflict. The findings provide valu-able insights for military decision-makers and technology developers in designing optimal AI integration strategies.

INTRODUCTION

Around the world, the amount of military hardware has grown yearly. every year, nations compete to produce or purchase the most advanced military hardware available to humanity. the development and application of artificial intelligence (AI) has become essential to the military. ai can be used in the military for a variety of equipment areas, all of which need to be developed because operations for people also require the ability for machines to reason. ai is used in the military for several purposes, including training fighter pilots by providing them with an unpredictable and adaptable opponent. ai is a vital instrument for boosting military capabilities, and it is also being used more and more in the planning and support of military operations. since artificial intelli-gence (AI) is predicted to impact the efficacy and efficiency of military operations sig-nificantly, funding for ai research and development has surged due to the military's requirement for cutting-edge technology (Scharre, 2019).

A few instances of its use, Artificial intelligence can be used in human resource training to prepare soldiers for combat scenarios even in the absence of a real battlefield. AI may be used to develop training programs and simulations in a variety of models that will be used to instruct soldiers in a range of combat systems. AI is used with virtual reality (VR) and augmented reality (AR) technology to create a virtual world that is more like the actual one.

A lot of sensitive and important data must be stored in space inside the cyber defense industry. Because of this, one of the primary targets of cyberattacks is the defense industry. Undoubtedly, a variety of security and protection strategies have been put into place to safeguard such private data. However, AI can be a valuable supplement to security measures to help stop unwanted invasions. In order to stop ransomware, intru-sions, malware, and other threats from entering the defensive network, threat monitor-ing activities also need to be carried out by network monitoring, i.e., by analyzing, assessing, and monitoring the organization's network and endpoints. It is possible to train machine learning algorithms to recognize patterns, identify malware, and identify ran-somware attacks before they infiltrate a system. Artificial Intelligence is also a major factor in the development of threat awareness systems deployed on drones. Drones are used by nations like the US, Russia, China, India, and others to identify hazards, particularly in distant places.

Can AI-driven autonomous weapon systems in the military be programmed to choose targets and execute targets without human oversight? It would take a long time to construct a weapon like this. However, AI is beginning to be incorporated into mili-tary platforms that are already in use, such loitering munitions and swarming drones. When these hordes of nimble drones are equipped with artificial intelligence, they can be used as tactical weapons to take down formations of armored cars and even fighter planes on the tarmac of military installations. The development of autonomous tanks using AI is another illustration of how these combat

vehicles can function without the need for human operators. or in highly developed missile systems. This also applies to explosives defusing. When robots and artificial intelligence (AI) work together, it can become a dependable explosive defuse that keeps humans safe. By deploying these clever, remotely operated devices, defusing explosives or bombs is safer for people to do (Scharre, 2018).

Logistics are an important consideration in military operations, just like in other fields. However, military logistics are not the same as regular logistical services. Military logistics systems are combined with machine learning and geographic analysis to minimize labor, time, and errors. The logistics system's efficiency, security, and safety are all enhanced by artificial intelligence. Artificial intelligence and machine learning can help with healthcare-related tasks on the battlefield, like remote surgical systems and evacuation operations. In the midst of a conflict, various robotic systems and ro-botic ground platforms with machine learning capabilities can assist in providing medical diagnostics and injury treatment (Rashid et al., 2023).

The application of AI to military technology in Indonesia is still in its early stages of development. In Indonesia, military hardware is produced locally in some instances, imported and subsequently self-developed in other cases, and imported and deployed immediately without further development. Numerous factors, some of which are specifically tailored to the military's operational objectives in Indonesia, have an impact on this. It is well known that Indonesia is a consumer nation, meaning it purchases goods from outside to support its military needs. This study will explain the signifi-cance of AI development for military technology in Indonesia. Despite Indonesia's cur-rent status as a consumer nation, there is still room to expand this technology for domestic purposes. Because, in reality, AI is needed in military technology (Johnson, 2019).

Indonesia, the world's biggest archipelago with over 17,000 islands, presents unique issues in resource management, connectivity, and public services. Its position on the Pacific and Indian Oceans makes it one of the most culturally, linguistically, and envi-ronmentally varied countries. While variety is a cultural strength, it also complicates regional cooperation and integration. To address these difficulties, Indonesia needs innovative and adaptable technology, where artificial intelligence (AI) comes into action.

Indonesia, an archipelago with multiple borders and a large territory, the primary goal of the defense sector is to patrol the border to prevent attacks on the area that belongs to a country. To protect its borders, the state sends out its armed troops. However, sophisticated devices like drones and intelligent sensors increasingly play a big part in border security systems. These drones have a variety of machine learning algorithms and software installed in them that scan, evaluate, and report any suspicious activities to a data center. AI technology eliminates the need for people to be present physically at borders and in potentially hazardous situations(Ayu et al., 2022).

Figure 1. Indonesia's Border Region

Source : https://www.scriblemaps.com/maps/view/peta-perbatasan-indonesia/RDmbBunFqf

RESEARCH METHOD

The method used by the author is descriptive qualitative. As explained by Cresswell that Qualitative is a research approach used to describe and analyze a phenomenon or event in a detailed, detailed, and comprehensive manner (Creswell, 2013). This approach aims to deeply understand the characteristics, context, and dynamics of a situation or event, without making statistical generalizations. This method is often used in social science, psychology, anthropology, and other fields where researchers want to understand in depth how a phenomenon occurs in a real context.

Descriptive qualitative methods often involve data collection through interviews, ob-servation, and document analysis, with a focus on collecting in-depth and detailed de-scriptive data. Data analysis in this method is done inductively, where specific findings are drawn from the data and then interpreted and described in detail. However, due to limited access and for the sake of data validity, the author chose sources from practi-tioner interviews, state documents and previous research as the main sources.

RESULTS AND DISCUSSION

In the age of contemporary warfare, artificial intelligence (AI) has emerged as a key driver in the transformation of military operations. The usefulness and efficiency of AI in this situation should not be underestimated. AI can handle huge amounts of data at speeds and precision that exceed human capabilities, resulting in in-depth and predic-tive strategic evaluations. AI may use machine learning algorithms to assess intelli-gence data, track adversary actions, and make suggestions based on

trends that humans may not see. Furthermore, the employment of artificial intelligence in automated weapon systems and unmanned vehicles improves response times and decreases threats to military personnel. However, this efficacy is not without drawbacks, such as possible exposure to cyberattacks or algorithm faults with serious implications. On the other hand, the operational savings that arise from AI integration have a positive influence, such as lower human training costs and time, as well as an enhanced capacity to carry out complicated and risky tasks (Horowitz et al., 2020). As such, AI is playing a crucial role in rethinking military strategy and tactics, ushering in a substantial transformation in the way military operations are carried out, but it still demands rigorous control and administration to fully realize its benefits.

AI Development in Modern Warfare

Artificial intelligence has emerged as a key driving force in the growth of modern war-fare. AI technological advancements have revolutionized the way major nations organize, execute, and manage their military operations since the turn of the twenty-first century. One of the most significant steps in this progress is automated systems' en-hanced capacity to evaluate enormous volumes of data and make strategic judgments in real time. This gives a substantial advantage in rapidly changing conflict scenarios, allowing for faster and more accurate decision-making than previous techniques. Ac-cording to Michael C. Horowitz's book 'The Future of Military Applications of Artificial Intelligence', advances in AI enable the development of more sophisticated weapon systems and the integration of technologies that support live data analysis to predict threats and respond to them efficiently (Horowitz et al., 2020).

Furthermore, robots and autonomous systems have played an increasingly important part in modern military operations. P.W. Singer's book 'Wired for War: The Robotics Revolution and Conflict in the 21st Century' accurately depicts how robotics and AI technologies have altered the terrain of armed conflict. Unmanned weapon systems, in-cluding drones and battle robots, are increasingly often utilized for reconnaissance, assault, and surveillance operations. The capacity to carry out risky tasks without engag-ing human beings decreases risk and boosts operational efficiency, but it also creates new issues in terms of ethics and control (Singer, 2009).

AI has also facilitated worldwide cooperation in military research and technology development. Countries such as the United States and China are competing for leadership in this sector, with each establishing sophisticated programs under the aegis of institutions like as the defence sophisticated Research Projects Agency (DARPA) in the United States. The book 'The Pentagon's Brain: An Uncensored History of DARPA' discusses DARPA's role in the creation of AI technology, as well as its effect on defence policy and worldwide military strategy. This agency's inventions not only boost the United States' position, but also have an impact on international power dynamics (Jacobsen, 2015).

Furthermore, AI's effect on military strategy extends to cyber conflict and cyber defence. In 'AI Superpowers: China, Silicon Valley, and the New

World Order', Kai-Fu Lee discusses how major countries like China and the United States are using AI technology to improve their cyber warfare capabilities. AI is used to prevent cyberattacks, detect possible threats, and protect key infrastructure from harm. These technologies give new instruments for a more sophisticated and potentially devastating virtual conflict. AI has a dual purpose in cybersecurity: it protects systems from assaults and it allows attackers to launch attacks more successfully. AI may be used to analyse attack trends, detect risks, and respond faster (Lee, 2018).

The US is currently working on developing artificial intelligence (AI) for use in modern warfare, which has profoundly altered military tactics and strategy. One such technique is the deployment of autonomous weapons systems, like combat drones. The "Phoenix" drone, for instance, uses algorithms to map the battlefield, analyse intelligence data, prioritize targets depending on dangers it has identified, and select and attack targets on its own. Phoenix can adjust to shifting circumstances as the mission goes on, utilizing machine learning to enhance its capacity to identify adversary movement patterns and discriminate between military and civilian targets, therefore lowering the likelihood of unintentional strikes (Pong, 2022). However, because algorithmic mistakes or misidentified targets might be lethal, the emergence of these autonomous drones presents ethical questions regarding judgments made by robots that affect life and death. While AI can improve military operations and save casualties on the battlefield, legislators and human rights advocates are deeply concerned about the possibility of losing human control over strategic choices.

Finally, AI-driven innovations in modern warfare have an impact on both the strate-gic and tactical components of military operations. Lawrence Freedman's 'The Future of War: A History' (2017) discusses how new technology, such as artificial intelligence, alter combat doctrine and tactics. These technologies allow for more dynamic and responsive planning, as well as the execution of more integrated and adaptable plans. According to Freedman, while AI has the potential to significantly increase effectiveness and efficiency, it also poses problems that military commanders must constantly adjust to. One major priority is the creation of autonomous systems capable of making judgments in combat scenarios without direct human participation. Freedman discusses how these systems may be utilized for warfare, surveillance, and weapons control tasks, as well as the ethical and legal implications of using this technology (Freedman, 2017).

Overall, the development of artificial intelligence has brought about Effective changes in the way warfare is conducted, from strategy to tactics and technology. It al-so brought the efficiency to Military operations in the field of navigation system, un-manned system, and all tools that facilitate military operations. The books mentioned above provide a comprehensive look at how AI is shaping the future of warfare and the challenges it faces.

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Military Technology Evolution

Military technology has become a critical pillar that defines operational effectiveness and strategy. These technologies encompass a wide range of innovations, from advanced weapon systems to analytics software that influence every aspect from planning to execution of military operations. These significant changes in technology have redefined the way warfare is conducted, providing a crucial strategic advantage in armed conflict.

One of the most striking advances in military technology is the development of high-precision weapon systems. These systems, including guided missiles and smart munitions, have improved strike accuracy and reduced collateral damage. Precision technology has now transformed combat tactics by enabling more targeted strikes and reducing risks to personnel and civilian infrastructure. Innovations in these technologies not only improve operational effectiveness, but also influence military strategy and international policy (Rip et al., 2002).

Military technology in ancient times was primarily concerned with inventing weapons and war vehicles that improved battle effectiveness. One of the most notable advancements was the employment of weaponry such as the bow and arrow and assault devices like the trebuchet. Bows and arrows, for example, had a longer range than me-lee weapons like swords, allowing warriors to attack from a safe distance. The ad-vancement of siege and defence technologies was significant during the Middle Ages. Siege engines like catapults and ballistae were employed to break through fortifica-tions and city walls, while more complicated fortification designs like bastions and ravelins were built to stop these attacks (Sidebottom, 2004).

The United States, a leader in the creation of cutting-edge weaponry and defence technologies, is one well-known example of how military technology has evolved. The US has made significant investments in R&D to produce more potent military technol-ogy since the end of World War II, beginning with initiatives like guided missile sys-tems and radar. As time has gone on, the emphasis has switched to more advanced technologies like artificial intelligence and driverless drones, with systems like the MQ-9 Reaper being utilized for stealth and precision strikes. Furthermore, because cyber technology can defend vital infrastructure from cyberattacks and manage weap-on systems over secure networks, its incorporation into military operations has grown in significance. In addition to altering US military tactics, these advancements have impacted international defence strategy and triggered a fresh arms race among coun-tries vying for military superiority. Every invention has brought up new moral and tac-tical difficulties that call for reconsidering the place of technology in armed conflicts down the road.

Military technology has undergone significant evolution from ancient times to the digital age. Each innovation brings about effective changes in the way war is conduct-ed, the strategies implemented, and the impact of conflict on global society. From bows and arrows to drones and cyber

warfare, technological advancements continue to shape the efficiency of military operations and war strategies around the world.

Future Warfare and Military Technology Growth

Military technological advancements continue to push the frontiers of how war is bat-tled, with important implications for the strategy and tactics used. In the digital era, new technologies like artificial intelligence (AI), robots, and automated weapon sys-tems have the potential to transform future military confrontations. This article will analyse future warfare forecasts, with an emphasis on technology advancements that are altering the battlefield terrain and their consequences for global strategy and security.

Artificial intelligence is expected to play a significant role in future battles by improving data processing, weapon system automation, and strategic decision-making. AI can accelerate information processing and deliver real-time insights, which are critical for planning military actions. For example, AI computers may analyse intelligence data from numerous sources to identify trends that human analysts may miss (Roy, 2024).

Furthermore, AI can enhance the automation of weapon systems and combat vehicles. Autonomous vehicles and battle robots outfitted with AI can complete tasks with low danger to human people, increasing combat operations' efficiency. However, the employment of AI in the military introduces new issues, such as the possibility of system failure and the ethical implications of utilizing technology in large-scale wars (Christie et al., 2024).

Cyber warfare has grown into a critical component in present and future battles. With an increased dependence on digital technology and information networks, cyberattacks on vital infrastructure, such as communications systems and power grids, can have far-reaching consequences. To protect data and systems from cyberattacks, military plans increasingly rely on cyber defence and attack skills. Cyber threats might include assaults that disable an adversary's military networks, damage weapon systems or steal important data. As a result, the development of strong cyber defence systems and methods to resist these attacks will be a major priority in future conflicts. Cybersecurity research and development are focused on detecting technologies and speedy response to threats (Obi et al., 2024).

Energy technology will also play a significant part in future conflicts. Energy-based weapon systems, such as lasers and directed energy weapons, provide additional options for defence and assault. Laser weapons, for example, may destroy or damage targets with great accuracy while minimizing collateral harm to the surroundings. Energy-based defence systems can improve defence capabilities against threats like mis-siles and drones. With the capacity to fire at light speed, these systems provide an ef-fective and efficient answer to long-range threats. Energy technology research is ongoing, with the goal of overcoming technological hurdles and

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improving the combat efficacy of these systems (de Courcy Wheeler & Brehm, 2017).

Future battles will be defined by the incorporation of modern technology that influences all aspects of military warfare. Artificial intelligence, robots, autonomous weapon systems, cyber warfare, and energy technologies will play important roles in military strategy and tactics. While these technologies have the potential to significantly increase the efficiency and efficacy of military operations, new obstacles will emerge, such as ethical concerns, hazards from automated systems, and cyber threats. As we enter this new era, military commanders and policymakers must understand and confront the consequences of these technologies to maintain global security and stability.

Military Impact After AI Contribution

Artificial intelligence has sparked big changes in a variety of industries, including the military. AI technology, which includes applications that include machine learning to natural language processing, has had a significant impact on military strategy and operations. The use of AI in the military not only improves operational efficiency, but it also raises complicated ethical and geopolitical issues. This article will investigate the many elements of AI's influence in the military setting, with an emphasis on weapon system development, operational efficiency, ethical implications, and associated problems and concerns (Rashid et al., 2023).\

AI has dramatically altered the face of military operations. In terms of intelligence collection, AI can assess data from many sources at speeds and precision that exceed human capabilities. Natural language processing (NLP) technology allows for the analysis of enormous amounts of text and speech data in order to extract vital information, discover trends, and forecast risks. For example, modern monitoring systems can evaluate adversary communications in real time and generate extensive analytical reports.

In terms of operational planning, AI serves as an invaluable strategic aid. Machine learning algorithms can simulate a variety of battle scenarios, assess risks, and offer the best strategies. This enables commanders to make better informed and strategic decisions, lowering uncertainty and increasing operational efficiency(Fazekas, 2021).

One of the most notable effects of AI in the military is the development of automated weapon systems. Combat drones and autonomous vehicles outfitted with AI algorithms may now carry out missions without direct human control. These drones can carry out high-precision reconnaissance, strikes, and search and rescue missions, lowering the risk to human workers. However, these developments introduce new obstacles. Automated weapon systems have the potential to accelerate and make conflict escalation more difficult to manage. For example, if one government uses autonomous weapons in a fight, other countries may feel forced to develop comparable technology, re-sulting in a potentially deadly arms

race. Furthermore, there is a possibility that AI systems would fail or make poor decisions, which might have disastrous effects.

AI also influences global power dynamics. Countries that can develop and implement sophisticated AI technology in their forces have a huge strategic edge. Military and technology forces are becoming more interconnected, and nations with better AI capabilities may gain an advantage in international war and diplomacy. These shifts may cause geopolitical instability, as governments that trail behind in AI technology development may feel threatened and driven to catch up aggressively. This might lead to conflicts between nations with and without modern technology, aggravating global inequality and raising the risk of violence (Polcumpally, 2022).

The influence of AI contributions on the military is a mix of enormous promise and difficult obstacles. While these technologies can help increase operational efficiency and military strategy, they also create serious ethical, legal, and geopolitical concerns. Moving forward, nations and the international community must take proactive steps to control these advancements, ensuring that AI technologies are utilized re-sponsibly and taking into account their influence on global peace and security.

Current Situation of AI Development in Indonesia

Despite increasingly complex geopolitical problems, Indonesia is currently experiencing a substantial change in the application of artificial intelligence (AI) in the military sector. This development is in accordance with the government's objectives to bolster national defence and security. The Indonesian government has made a commitment to modernizing the armed forces in recent years, with the integration of cutting-edge technologies like artificial intelligence being one of the primary goals. The Indonesian military wants to become more competitive in the region and more efficient in its operations, according to a study from the Ministry of Defence (Dwipratama, 2024).

Boosting the capability of drones and surveillance systems is one of the tactical measures the Indonesian military is taking to develop AI. Given that maintaining sovereignty at sea is extremely difficult for Indonesia, a country made up of hundreds of islands, developing drones for surveillance and monitoring purposes is a top concern. A defence research centre study found that using AI-based drones can assist identify threats more swiftly and correctly while also supplying vital intelligence data. The In-donesian military intends to improve marine surveillance and threat response with this capacity (Sharkey, 2011).

PT. Dirgantara Indonesia and the government came up with the Unmanned Aerial Vehicle (UAV) Elang Hitam and used it in the Kalimantan area after realizing this. The Elang Hitam UAV searches the skies with incredible speed and accuracy while operating as a contemporary eye and ear in the heart of West Kalimantan's deep tropical forest. With its advanced technology that enables real-time image and data recording, this drone is designed to monitor and oversee difficult-to-reach locations. This will aid

authorities in their efforts to prevent illicit operations like mining and logging, as well as deforestation. This UAV is an essential instrument for protecting wildlife and maintaining the environment because of its highflying altitude and capacity to cover a wide range of area. Furthermore, Elang Hitam's presence offers enhanced understanding of climate change and its effects on biodiversity in the region, positioning it as a trailblazer in sustainable conservation initiatives in West Kalimantan (Utama & Anwar, 2021).

Overall, the Indonesian military's adoption of artificial intelligence demonstrates a growing understanding of the significance of keeping up with international technology advancements. Even if there are numerous obstacles to overcome, the government's actions indicate that it wants to strengthen defences while also equipping the Indonesian armed forces to meet new challenges. For Indonesia to fully utilize AI in preserving its national security and sovereignty, funding for research, education, and international collaboration is crucial.

CONCLUSIONS AND RECOMMENDATIONS

AI has significantly changed the landscape of military technology, with serious consequences for the effectiveness and efficiency of military operations. The integration of military AI weapon systems and technologies not only enhances accuracy and detecting capabilities but also allows for automation, reducing reliance on human interaction. In this aspect, AI can process huge amounts of data at rates significantly above human capabilities, giving it a strategic advantage in mission planning and execution. Intelligent defence technologies, such as automated firing control and predictive analytics, improve the capacity to respond to threats more quickly and accurately. As a result, AI not only enhances the military's capacity to act and respond, but also aids in detecting possible threats and developing more effective plans.

In terms of efficiency, the use of AI in military operations helps to reduce the costs and resources needed for mission execution. AI reduces the need for employees to work in regular and repetitive jobs by automating processes and employing algorithms capable of processing information in real time, as well as lowering the danger of human mistakes. Furthermore, artificial intelligence allows for more effective planning and logistics, optimizes resource use, and reduces waste. The use of AI in military systems also accelerates decision-making by giving more accurate and up-to-date infor-mation. Overall, the impact of AI on military technology not only gives an operational edge, but it also improves efficiency and effectiveness in the execution of military missions.

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