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The Role of Unmanned Aerial Vehicles (UAVs) in Indonesian Air Defense Management

Shafira Karunia Hildawati[1)], Susilo Adi Purwantoro [2)], Editha Praditya Duarte [3)], Fachmi Khoiruddin [4)] Hikmat Zakky Almubaroq [5)]
[1,2,3,5)] Defense Management, Defense Management Faculty, Republic of Indonesia of Defense University
[4)] Power Motion Technology, Science and Technology Faculty, Republic of Indonesia of Defense University

*Corresponding Author
Email: shafirakarunia11@gmail.com

Abstract
Indonesia is an archipelagic state with land and maritime borders with other nations. The use of Unmanned Aerial Vehicles (UAVs) has become crucial in safeguarding Indonesia's defense and border areas. This research employs a qualitative method, aiming to gain a deep understanding of the role of UAVs in the Defense management of Indonesia's, covering complex aspects such as policies, implementation, and their impact. The findings reveal that sustained investment in UAV technology and infrastructure is essential to strengthen Indonesia's air defense capabilities. Particularly, High-Altitude Long Endurance (HALE) UAVs prove to be effective and reliable in surveillance with their ability to operate at high altitudes and for extended durations. In the context of Indonesia's air defense, UAVs significantly enhance surveillance, reconnaissance, and national security. Effective integration and utilization of UAVs are key to maintaining protection and sovereignty over the airspace. Appropriate regulations and the establishment of ownership registries are crucial to support responsible UAV usage, especially concerning national security and counterterrorism. The evolving significance of UAVs will continue to shape defense paradigms in the future.

Keywords: Air Defense, Defense Management, Unmanned Aerial Vehicles.

INTRODUCTION

Indonesia, as an archipelagic nation with land and maritime borders shared with several neighboring countries, faces serious challenges in safeguarding its boundaries. One prominent land border area is with Malaysia, Papua New Guinea, and Timor Leste. Meanwhile, in the waters, Indonesia shares borders with ten countries, including India, Singapore, Malaysia, Thailand, Vietnam, the Philippines, Palau, Australia, Timor Leste, and Papua New Guinea. Although the Indonesian National Armed Forces (TNI) have deployed Border Security Task Forces (SATGAS PAMTAS) to secure these regions, the existing security system is not entirely effective in monitoring the entire border (TNI AD, 2022). This often leads to undetected violations. Therefore, further efforts are needed to enhance the effectiveness of border security systems to preserve the nation's sovereignty and prevent potential threats from various parties.

The use of unmanned aerial vehicles (UAVs) is becoming increasingly widespread as an important tool in air defense management across the globe. The Indonesian Air Defense Management system is no exception, and with the country's vast airspace and topography, there is a need for advanced technologies to secure the skies. UAVs, with their ability to be remotely controlled and to remain airborne longer than manned aircraft, have the potential to enhance the air defense capabilities of Indonesia. An Unmanned Aerial Vehicle (UAV) is an airborne vehicle that doesn't require a pilot on board and can be remotely controlled or move automatically based on the parameters programmed into its control system. The UAV utilizes the principles of aerodynamics to generate lift and produce movement during its flight. These aerodynamic principles encompass concepts such as air pressure, lift force, and air resistance, enabling the UAV to fly and navigate through the air (Ramahan, 2022).

The pilot or operator of the UAV can control its movement, navigation, and other functions using remote control or through pre-programmed automated programs. The utilization

of UAVs has expanded into various industries, including security, aerial mapping, environmental monitoring, agriculture, and other sectors. The primary advantage of UAVs is their ability to perform specific tasks without the need for human presence on board. This makes UAVs highly useful in situations that are high-risk or difficult to access for humans. In the context of security, UAVs are frequently used for reconnaissance missions, border surveillance, and threat detection without risking human lives. Moreover, the UAV's capability to fly for extended durations compared to manned aircraft allows it to carry out longer-duration missions (Becerra, 2019).

Unmanned Aerial Vehicles (UAVs), also known as drones, have revolutionized various industries worldwide, including the field of air defense management. In the context of Indonesia, the role of UAVs in air defense management has become increasingly significant. With their ability to operate without endangering human lives, these unmanned aircraft serve as valuable tools for surveillance, reconnaissance, and threat detection. By providing real-time aerial intelligence, UAVs enhance the effectiveness and efficiency of the Indonesian Air Defense Management system. The multifaceted roles and advantages of UAVs in safeguarding Indonesian airspace, highlighting their contribution towards strengthening national security. With the rapid development of UAVs technology today, UAVs can be used as a component of air power (Djafar, 2020).

The use and role of UAVs in the development of national defense and the independence of the defense industry have a significant impact on Indonesia. The advanced defense industry plays a crucial role in providing defense technology, which, in turn, can boost Indonesia's independence in the future. The importance of domestically produced advanced defense technology also creates a competitive advantage, with its hidden excellence challenging for foreign entities to decipher. This aids in supporting the fulfillment of independent and robust Defense and Security Equipment (ALPALHANKAM) needs in the future.

At the end of 2019, the Unmanned Aerial Vehicle Complex (PTTA MALE) launched the prototype of the "Medium Altitude Endurance (MALE)" aircraft. The Medium Altitude Long Endurance Unmanned Aircraft, or Puna Male type, named the Black Eagle, has the capability to fly for 30 hours. This drone can reach speeds of up to 235 km per hour and operate at altitudes of 10,000-30,000 feet. Weighing 1,300 kilograms, with a length of 8.65 meters, a wingspan of 16 meters, and a height of 2.6 meters, the drone is designed to carry loads of up to 300 kilograms. The use of drones like this has significant potential in enhancing defense by improving surveillance, reconnaissance, and effective responses to potential threats. The utilization of UAVs contributes substantially to strengthening national defense and fostering independence in the defense industry, positioning Indonesia as a technologically competitive player on the global stage (Nurhuda et al., 2022).

Furthermore, UAVs have become a game changer in warfare. Evidently, during the six-week war in the fall of 2020, the Azerbaijani armed forces were able to destroy Armenian artillery batteries by relying on UAVs. During the war, Azerbaijan relied heavily on the use of drones/UAVs to identify, targeting and attack Armenian defense positions and armored units (Welt & Bowen, 2021). As a result, Armenia lost the Nagorno-Karabakh region. Unmanned Aerial Vehicles (UAV) technology or unmanned aircraft or known by some in the general-public as drones, is starting to take over the role of conventional models that rely on fighter aircraft and direct visual observation. These targeted strikes via drone strikes have transformed the battle space, making physical occupation no longer necessary. In addition, UAVs can perform infinitely complex forms of command in unruly spaces filled with uncertainty, violence, and danger (Aguis, 2017). In the future, this trend is likely to continue and get stronger.

With the continuous advancement of technology, UAVs have become increasingly essential in various applications, providing positive contributions to efficiency, security, and accuracy across different sectors of life. This paper aims to explore the potential roles of UAVs

in the Indonesian air defense management system, assess their effectiveness and identify the operational and tactical advantages they bring to air defense missions. The paper will also evaluate the current regulatory and legal frameworks surrounding UAVs in Indonesia, and suggest recommendations for the establishment of a comprehensive and safe UAV air defense management system to optimize the use of these unmanned platforms in securing the national airspace.

RESEARCH METHODS

In this research, a qualitative method is employed. Qualitative research is the study of the nature of phenomena, which includes their quality, different manifestations, the context in which they appear, or the perspectives from which they can be perceived, but excludes their range, frequency, and place in an objectively determined chain of cause and effect (Eze, 2023). The qualitative approach is chosen because this study aims to gain an in-depth understanding of the role of Unmanned Aerial Vehicles (UAVs) in Indonesian air defense management, encompassing complex aspects such as policies, implementation, and their impacts. Through the qualitative approach, the research will involve document analysis, interviews with defense experts, and observations related to the utilization of UAVs in the context of Indonesian air defense. The qualitative method will enable us to explore nuances and contextual factors that cannot be directly quantified, thereby supporting a more holistic achievement of the research objectives.

RESULT AND DISCUSSION

Indonesian Geographic Extent

Indonesia, as an archipelagic nation situated in Southeast Asia, possesses a vast and diverse airspace that plays a crucial role in the country's geographical landscape. With a territorial expanse spanning across over 17,000 islands, the Indonesian archipelago spans both sides of the Equator, giving it a unique position and a vast geographic area in terms of airspace. The Indonesian archipelago stretches from the western tip of Sumatra to the easternmost part of Papua, covering approximately 1.9 million square kilometers, making it one of the largest nations in terms of territory.

The geography of Indonesia's airspace is marked by a rich and varied topography. It includes towering mountain ranges such as the Himalayas to the west, dense tropical rainforests, expansive lowlands, vast seas, and an intricate web of water bodies, including the Indian Ocean to the south and the Pacific Ocean to the east. This geography, combined with the equatorial climate, gives rise to a wide range of weather patterns and climate zones, influencing the management of airspace and air travel in the region.

Indonesia's airspace is of great strategic significance, given its proximity to key global trade routes and the presence of busy international airways that crisscross the region. The archipelagic nature of the nation presents unique challenges and opportunities in terms of managing its airspace effectively. The Indonesian government, in accordance with international laws and regulations, has established specific rules and procedures for the management of its airspace, emphasizing national sovereignty and security, safety, and international cooperation.

The country's airspace is vital not only for domestic air travel but also for regional air transportation and connectivity. Indonesia is home to several international airports, including Soekarno-Hatta International Airport in Jakarta, Ngurah Rai International Airport in Bali, and Juanda International Airport in Surabaya, which serve as important hubs for both passengers and

cargo transportation within Southeast Asia and beyond. Indonesia's strategic location places it at the crossroads of various air corridors, making it a critical player in regional air traffic and air defense. The establishment of the National Air Operations Command (Koopsudnas) is an effort to enhance anti-access/area denial capabilities (Widjayanto, 2022). As such, the Indonesian government places a strong emphasis on the protection and sustainable management of its airspace, ensuring the safety and security of air travel, as well as contributing to regional stability and cooperation. It presents both opportunities and challenges for the country, which are addressed through meticulous management, international collaboration, and adherence to sovereign rights, ensuring the safe and secure use of this vital resource for the benefit of the nation and the broader region.

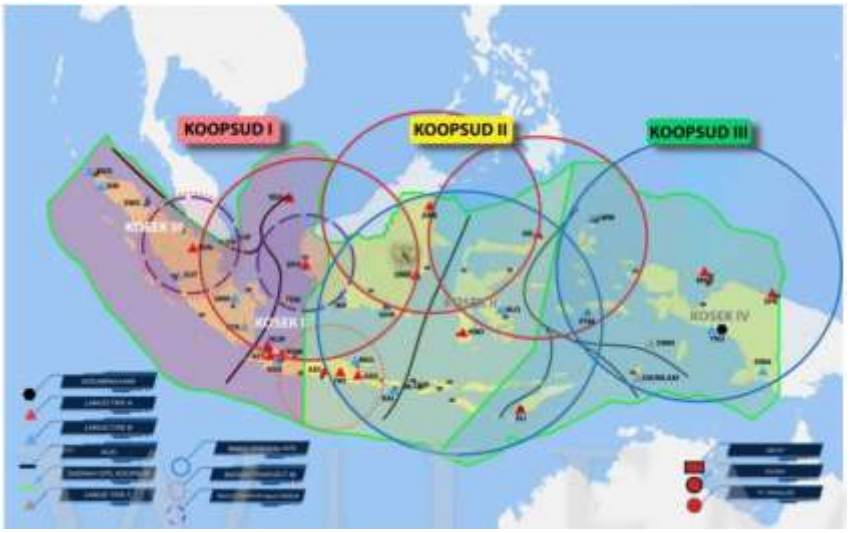

Figure 1. Indonesian Air Defense Identification Zone
Source: Andi Widjayanto (2022)

There are several issues that frequently occur and pose disruptions in our efforts to safeguard Indonesia's airspace sovereignty. One of the challenges lies in the less-than ideal personnel or military forces responsible for airspace sovereignty protection, both in terms of quantity. Additionally, airspace violations necessitate the Indonesian Air Force (TNI AU) to carry out identification and, if necessary, destruction measures.

Technology Development

Drone technology is a relatively new field in military technology, where military engineers have been working on incorporating artificial intelligence into drones to create products that, in some cases, may rival the performance of human reconnaissance teams. Companies like Shield.AI, AeroVironment, and Lockheed Martin are all exemplifying how military defense contractors are combining computer vision and image recognition technology with drones to address military challenges without endangering human lives. Unmanned aerial vehicle remote sensing can find application in various UAV-related fields such as land surveying, mapping, earthwork surveys, detecting natural disasters, forest patrols, aerial photography, and more. By utilizing unmanned aerial vehicles, remote sensing sensors, GPS, and other technologies, we can swiftly acquire spatial remote sensing information pertaining to local environments and resources. This information can then be analyzed, integrated into Building Information Modeling (BIM), and comprehensively utilized. The technology for real-life modeling through UAV tilt photography involves capturing high-resolution aerial photographs with a combination of UAVs, pan/tilt cameras, positioning control points, aerial survey calculations, and other technologies (Wu, 2021).

The Indonesian Ministry of Defense has implemented a policy that governs the deployment of unmanned aircraft in a wide range of military and non-military missions undertaken by its armed forces. This initiative not only underscores the importance of leveraging unmanned aerial technology for various operational purposes but also seeks to promote self-reliance within the defense industry for the development of unmanned aircraft. The defense industry in Indonesia places a significant priority on the development of various key aspects to strengthen the nation's defense capabilities. These priorities encompass a diverse range of defense equipment and technology, including submarines, fighter aircraft, propellants, missiles, rockets, radar systems, medium tanks, Unmanned Aerial Vehicles (UAVs), military satellites, and underwater sensing technology (Defense Industry Policy Committee, 2023). The focus on these ten crucial elements underpins Indonesia's commitment to enhancing its military capabilities and ensuring its readiness to address various national security challenges. This strategic emphasis on a well-rounded defense portfolio showcases the country's determination to be prepared for both contemporary and future threats, thereby contributing to its overall security and defense preparedness.

DEFENSE INDUSTRY PRIORITY
Submarines
Fighter Aircraft
Propellants
Missiles
Rockets
Radar Systems
Medium Tanks
Unmanned Aerial Vehicles (UAVs)
Military Satellites
Underwater Sensing Technology

Figure 2. Indonesia Defense Industry Priority
Source: Defense Industry Policy Committee (2023)

The Legality of Unmanned Aerial Vehicle (UAV) Utilization Based on the 1944 Chicago Convention

The utilization of Unmanned Aerial Vehicles (UAVs) has rapidly expanded in recent years, revolutionizing various industries from defense and agriculture to environmental monitoring and disaster response. However, as UAV technology continues to advance, questions surrounding its legal framework and compliance with international conventions have come to the forefront. One of the key international agreements that plays a pivotal role in regulating aviation is the 1944 Chicago Convention. In this context, it is imperative to examine the legality of UAV utilization within the framework of the Chicago Convention to ensure that these unmanned aircraft operate in accordance with international law and regulations. This discussion seeks to explore the legal aspects of UAV deployment in light of the Chicago Convention and its implications for both military and civilian applications (Sumendap, 2023),The utilization of airspace in Indonesia, in accordance with the Government Regulation of the Republic of Indonesia Number 4 of 2018 concerning the Security of Indonesian Airspace, encompasses various aviation means, as outlined by (Darwis, 2018) These means include:

1. Aircraft
2. State Aircraft
3. Foreign State Aircraft
4. Indonesian Civil Aircraft
5. Foreign Civil Aircraft
6. Indonesian National Defense Aircraft

7. Interceptor Aircraft
8. Unmanned Aerial Vehicles (UAVs)

Indonesia's airspace sovereignty is a vital component of the nation's security and territorial integrity. The country's breathtaking landscapes and vital resources are not only a source of national pride but also critical for economic and environmental well-being. However, beneath the surface of this awe-inspiring beauty lies a complex set of challenges. The dedicated personnel entrusted with safeguarding Indonesia's airspace face persistent obstacles that hinder their mission. One pressing issue is the inadequate number of troops available for this crucial task, which has become a recurring problem. Moreover, the airspace frequently witnesses violations that necessitate the Indonesian Air Force's (TNI AU) response, involving identification and, at times, the most extreme measure of destruction. These challenges underscore the need for a more comprehensive approach to strengthen the nation's capacity to protect its airspace effectively (Savitri & Prabandari, 2020).

International aviation law adheres to a legal framework established through various conventions on international aviation law, including the Convention Relating to International Civil Aviation signed at Chicago (Chicago Convention) in 1944. These distinctions set the stage for exploring the legal framework governing UAV usage within the international aviation context, as prescribed by the Chicago Convention and other relevant international agreements. Before embarking on any international flight, all types of aircraft from participating countries are required to possess a distinct nationality. The determination of the nationality of aircraft from participating countries serves two essential purposes:

1. Flight Responsibility

Each participating country overseeing aircraft can issue the necessary technical documents, including flight certificates, proficiency badges, and more, ensuring the compliance of the aircraft with aviation standards and regulations.

2. Flight Protection

An aircraft can declare its origin from a specific country, allowing it, when necessary, to seek assistance from its diplomatic representatives if it encounters issues while abroad. This dual significance not only reinforces aviation standards but also ensures the safety and protection of international flights.

Concerning the use of government-owned unmanned aerial vehicles (UAVs) for governmental purposes, these aircraft are classified as state aircraft. When discussing the legal aspects of UAV utilization in Indonesia, the regulation that closely aligns with this issue is the Ministry of Transportation of the Republic of Indonesia Regulation Number PM 37 of 2020 regarding the Operation of Unmanned Aerial Vehicles in the Airspace Served in Indonesia. This regulation covers various aspects, including:

1. The operation of unmanned aerial vehicles in Indonesia.
2. The operation of unmanned aerial vehicles in the airspace served in Indonesia.
3. The imposition of penalties.

These guidelines establish a comprehensive framework for UAV operations within Indonesian airspace, ensuring their adherence to established rules and regulations.

Unmanned Aerial Vehicles (UAVs)

Before delving into its regulations, it's important to understand the categorization of Unmanned Aerial Vehicles (UAVs) (Sumendap, 2023):

a. Non-Combat UAV

Non-Combat UAVs are UAVs that are entirely unarmed and, in practice, are primarily used for reconnaissance and data collection.

b. Combat UAV

Combat UAVs are equipped with weaponry, designed to engage in direct attacks on their operational targets, potentially causing significant damage.

c. Drone

Drones are unmanned aerial vehicles typically employed for recreational and agricultural purposes by the general public.

Research on Unmanned Aircraft Vehicle (UAV) or unmanned aircraft system (UAS) are increasingly becoming popular in recent times and are widely used for various commercial or military purposes like photogrammetry, surveying, remote sensing for mapping, rescuing as well as for military purposes, Intelligence, Surviellance, and Reconnaisance (Chaurasia, 2021).

Unmanned Aerial Vehicles (UAVs) encompass various types, each specifically tailored to serve distinct functions and address particular operational requirements. These adaptable aircraft can be broadly categorized based on their intended roles, demonstrating their versatility and wide-ranging applications. There are surveillance and reconnaissance drones, which come equipped with advanced cameras and sensors. These UAVs play a critical role in real-time intelligence gathering, remote area monitoring, and aerial surveys. On the military front, UAVs are engineered for tactical and strategic missions, covering activities like surveillance, target identification, and even combat. They frequently incorporate advanced weaponry and technologies to support their roles in defense and security operations. For future war scenarios, the military is steadfastly developing a network of ground and air drone vehicles and artificial intelligence to assist the battle analysis system (Susdarwono, 2021).

The advancement of technology and national defense needs have made the development of Unmanned Aerial Vehicles (UAVs) a priority in Indonesia's aerospace development. UAVs are unmanned aircraft designed to serve various defense functions, including combat and reconnaissance. They offer advantages in overcoming challenges often associated with conventional fighter aircraft, such as pilot risk and high operational costs. Additionally, UAVs possess the capability to execute missions that are otherwise unfeasible for traditional fighter aircraft, such as deep penetration into enemy territory and border surveillance, as well as offensive operations (Utama & Anwar, 2021). Therefore, the design of UAVs should be approached as an optimization problem that involves various design requirements across multiple disciplines (Coppin, 2014). In accordance with Law No. 26 of 2016, several classifications of Defense Technology and Equipment Procurement (UAV) are regulated, which can be viewed as follows.

Tabel 1. Classification of UAV

No	Classification	Weight (Kg)	Operational Altitude (ft)	Operational Radius (Km)	Operational Time (h)	User	Military Operation Mission
1	Micro	< 2	< 200	< 5 LOS	< 5	Individual – Platoon	
2	Mini	2-20	< 3000	< 20 LOS	< 10	Tactical Battalion	Photography, Data Collection, Inspection, Launching Equipment, Cargo Transportation, Relay Stations, Mitigation, Denial, Security,
3	Small	20-150	< 5000	< 50 LOS	< 24	Tactical Brigade	
4	Medium	150-600	< 10.000	< 200 LOS	< 48	Tactical Formation	
5	Large	> 600					
	MALE	> 600	< 45.000	Unlimited BLOS	> 120	Theater Operational	
	HALE	> 600	< 65.000	Unlimited BLOS	> 120	STRATEGIC / NATIONAL	
	COMBAT	> 600	< 65.000	Unlimited BLOS	> 120	STRATEGIC / NATIONAL	

							Surveillance, and Monitoring.

Source: Ministry of Defense of Indonesia (2016)

The emerging threats can be observed both from external and internal sources, such as the increasing number of violations in Indonesia's airspace, as reported by the Indonesian Air Force (Handini & Risdiarto, 2019). When managing the national air defense system against a variety of threats and potential threats, the readiness of fighter jets and mastery of defense technology, especially in air defense, become paramount. It is this air defense technology that has now become a critical factor in securing the airspace. One of the current air defense technologies is the utilization of Unmanned Aerial Vehicles (UAVs), used for aerial surveillance and as destructive weapons, as UAVs can carry weapons or function as weapons themselves (kamikaze) (Utama & Anwar, 2021).

Air Defense Concept, Roles and Place of Management in Different Defense Organizational Levels

The main components of defense are developed through a capability-based approach, encompassing the modernization-oriented development of the Navy and Air Force and the consolidation for the Army. This framework allows the implementation of capability-based defense (Bimantoro, 2019) which includes:

1. Having minimum essential forces
2. Addressing real and pressing task execution while building deterrence capabilities
3. Adapting to the developments in the modern military world (Revolution in Military Affairs)
4. Gradually building capabilities in line with the state's economic and financial capacity; and
5. Prioritizing the utilization of the National Industry.

Roles and place management within defense organizations play a pivotal role in ensuring the effective operation of military and security structures. These functions are distributed across different organizational levels, each with its specific responsibilities and areas of focus. At the strategic level, senior leaders set policies, allocate resources, and shape long-term defense strategies. The operational level focuses on planning and executing military campaigns, allocating resources, and coordinating various elements of the military. At the tactical level, troops on the ground, in the air, or at sea execute specific operations, plan missions, handle logistics, and engage in direct combat (Bucur, 2009). The effective distribution of roles and responsibilities at each level ensures that defense organizations can respond to security challenges and threats in a coordinated and efficient manner, safeguarding national security interests.

Level	Policy	Planning	Management
Strategic	National security strategy Strategic defence concept	Defence planning directive Strategic capabilities plan	• how to implement strategic policies and plans • identify and solve strategic problems
Operational	Military strategy Executive policies (i.e. personnel, procurement, public affairs) Joint service (Army, Air, Navy) doctrines	Operational plans Capability development programmes Procurement programmes Training programmes	• how to implement operational policies, strategies and doctrines • identify and solve operational problems
Current	Terms of reference Organisation's mission statement Standard Operating Procedures (SOP) Job descriptions	Work plans Exercise plans Field operations plans	• how to implement organisational policies and current plans • identify and solve current problems

Figure 3. Roles and Place of Management in Different Defense Organizational levels.
Source: Defense Management, An Introduction Book (2009)

Usability UAVs in Indonesia

In the present day, drones primarily perform intelligence, surveillance, target acquisition, and reconnaissance functions. This necessitates the collection of information about the targeted area, local conditions, and potential targets, including individuals, using various sensors like infrared, radar, radio frequency, thermography, and sound. Medium Altitude Long Endurance (MALE) drones and High-Altitude Long Endurance (HALE) drones are two types of drone systems used for extended surveillance periods. MALE drone systems typically fly at altitudes ranging from 25,000 to 50,000 feet and can remain airborne for up to 24 hours. As the name suggests, HALE systems can fly at altitudes of up to 60,000 feet for up to 32 hours (Zwijnenburg, 2018).

Figure 4. WULUNG UAV
Source: Indomiliter (2019)

The use of Unmanned Aerial Vehicles (UAVs) for various purposes, deemed cost-effective in terms of operations, creates a sense that countries are racing in development, including Indonesia during President Joko Widodo's administration. For a nation with vast land and water territories like Indonesia, the utilization of drone technology, particularly for regional security, is highly advantageous, especially in reaching remote and challenging terrestrial and maritime locations, ultimately saving lives (Ardhiansyah, 2022). The current military requirements for drones in Indonesia are among the most pressing, as the presence of various types of military drones will enable the completion of various missions using cutting-edge technology. Consequently, Indonesia must increase its UAV drone inventory, especially those of high quality, both HALE and MALE types and autonomous unmanned vehicles (UAVs) within a multifaceted tactical environment (Boord, 2016).

The utilization of UAV systems can serve as a viable alternative for addressing a range of existing issues and adapting to the ongoing and rapid technological advancements in alignment with the Revolution in Military Affairs (RMA). The UAV system possesses unique advantages in terms of aerial surveillance within the national territory, including its altitude, flexibility, and operational range. By leveraging these attributes, performance-related risks can be mitigated, and the capacity for extended flight durations becomes a significant consideration. This is of utmost importance, as UAVs can function as a dependable weapon system supporting national defense. The development of a UAV system that emphasizes technological advancements, integration, and interoperability is pivotal, as it represents an effective and efficient solution for the future, crucial in upholding the territorial integrity of the Unitary State of the Republic of Indonesia and safeguarding the entire nation against various threats (Pasaribu, Bonar, & Anwar, 2017).

Presently, there are no regulations in place concerning the utilization of UAVs with regard to national security, and none necessitate UAV operators to maintain asset documentation. The absence of UAV regulatory frameworks in Indonesia creates vulnerabilities for potential misuse of UAVs in acts of terrorism. Therefore, the Indonesian People's Consultative Assembly (DPR) should advocate for the development of comprehensive regulations governing UAV usage. Additionally, the establishment of a UAV ownership registry is deemed necessary. Apart from facilitating the monitoring of potential UAV misuse, this registry could also serve as a potential revenue source for the nation. Furthermore, it should be fortified with licensing requirements similar to those employed by countries such as Australia, Saudi Arabia, and the United Arab Emirates. (Ulfa, Riyono, & Christianingrum, 2021). Therefore, the utilization of Unmanned Aerial Vehicle (UAV) systems fundamentally represents the appropriate choice for resolving ongoing issues, aligning with the response to the rapid technological advancements and in line with the implementation of the Revolution in Military Affairs (RMA), aimed at achieving Network-Centric Warfare capabilities or Centralized Operations (Sulo, 2022).

CONCLUSION

The critical role of Unmanned Aerial Vehicles (UAVs) in the management of Indonesian air defense. UAVs have proven to be versatile and valuable tools in enhancing surveillance, reconnaissance, and the overall security of the nation's airspace. Their ability to provide real-time intelligence and monitoring capabilities, along with their potential applications in both military and civilian sectors, underscores their significance in safeguarding Indonesia's airspace. The findings suggest that continued investment in UAV technology and infrastructure is essential to further strengthen the country's air defense capabilities. As technology continues to evolve, the integration and effective utilization of UAVs are paramount in ensuring the continued protection and sovereignty of Indonesia's airspace.

The rapid advancements in technology have propelled UAVs into the forefront of military and defense strategies, enabling them to perform critical functions such as intelligence gathering and target acquisition. Medium Altitude Long Endurance (MALE) and High-Altitude Long Endurance (HALE) drones offer extended surveillance capabilities, with HALE systems reaching higher altitudes and longer flight durations. These UAVs have proven to be cost-effective and versatile tools, making them an attractive option for many nations, including Indonesia. The development and regulation of UAV technology, as well as the establishment of ownership registries, have become essential steps in ensuring responsible and secure UAV usage, especially in the context of national security and counterterrorism efforts. UAVs, with their unique advantages and adaptability, stand as a pivotal component of modern defense strategies, contributing to the protection of national territories and safeguarding against emerging threats and challenges.

REFERENCES

Aguis, C. (2017). Ordering without bordering: drones, the unbordering of late modern warfare and ontological insecurity. *Postcolonial Studies*.

Ardhiansyah. (2022). Urgensi Pengaturan Unmanned Aircraft Vehicle (UAV) Sebagai Senjata Menurut Hukum Humaniter Internasional. *Diversi Jurnal Hukum*, 150-179. Retrieved from Diversi Jurnal Hukum.

Bimantoro. (2019). Analisis Strategi Personal Selling Marketing Communication di PT.Infoglobal. *Manajemen Bisnis*. 22(1):43-63.

Boord, W. J. (2016). *Air and Missile Defense Systems Engineering.* London: CRC Press.

Bucur, H. (2009). *Defense Management: An introduction Vol.1*. Geneva Centre for the Democratic Control of Armed Forces.

Chaurasia, R. (2021). Unmanned Aerial Vehicle (UAV): A Comprehensive Survey. In R. Chaurasia, *Unmanned Aerial Vehicles for Internet of Things (IoT): Concepts, Techniques, and Applications* (pp. -). Scrivener Publishing LLC.

Coppin. (2014). Aerodynamics, Stability and Shape Optimisation of Unmanned Combat Aerial Vehicle. Sheffield. *University of Sheffield*.

Darwis. (2018). Politik Hukum Memanfaatkan Wilayah Udara Untuk Kepentingan Penerbangan Di Wilayah Kedaulatan NKRI. *Jurnal Ilmiah Hukum Dirgantara*. 6(1):1-18.

Defense Industry Policy Committee. (2023, February 20). Rencana Aksi Industri Pertahanan: Penguasaan Sepuluh Teknologi Prioritas. *Defense Industry Priority*.

Djafar, A. (2020). Pembuatan Dan Potensi Pemanfaatan Unmanned Aerial Vehicle (UAV) Untuk Keamanan Wilayah Rt. 19 Kelurahan Karang Joang Tahun 2020. *Jurnal Pengabdian Masyarakat Berkemajuan*. 4(1):546-551.

Eze, V. H. (2023). Qualitative Research. *IDOSR Journal Of Computer And Applied Sciences.* 8(1):20-35.

Handini, & Risdiarto. (2019). Kedaulatan Wilayah Udara Di Atas Alur Laut Kepulauan Indonesia (ALKI). *Journal Rechts Vinding Media Pembinaan Hukum Nasional*. 8(2):277-292.

Pasaribu, Bonar, & Anwar. (2017). Penggunaan Sistem Unmanned Aerial Vehicle dalam Pengamanan Wilayah Perbatasan Indonesia-Malaysia (Studi Interoperabilitas Skadron Udara 51 TNI AU dan Direktorat Topografi TNI AD). *Jurnal Prodi Strategi Pertahanan Udara*. 3(2): 115-139.

Savitri, R. N., & Prabandari, A. P. (2020). TNI Angkatan Udara dan Keamanan Wilayah Udara Indonesia. *Jurnal Pembangunan Hukum Indonesia*. 2(2):236-245.

Sulo, A. F. (2022). Pemanfaatan UAV Untuk Mendukung Pertahanan Udara IKN Nusantara Sebagai Center Of Gravity. *Jurnal Education and Development*. 10(3):1-6.

Sumendap, F. E. (2023). Legalitas Pemanfaatan Unmaned Aerial Vehicle (UAV) Berdasarkan Konvensi Chicago 1944 Dan Pengaturan Hukum Udara Di Indonesia. *Journal of Lex Generalis*. 4(1): 195-207.

Susdarwono, E. T. (2021). Artificial Intelligence (AI) Drone Dalam Pertahanan: Problem Dan Kemajuan. *Jurnal Ilmiah Intech : Information Technology Journal of UMUS*. 3(1): 1-11.

Ulfa, Riyono, & Christianingrum. (2021). Potensi Drone Menjadi Aksi Terorisme. *Budget Issue Brief politik dan Keamanan*.

Utama, & Anwar. (2021). History Of The Use Of Unmanned Aerial Vehicle (UAV) In The Modern War And The Preparation Of The Indonesian Military. *Jurnal Pertahanan dan Bela Negara*. 11(3): 167-181.

Welt, C., & Bowen, A. S. (2021, January 7). Azerbaijan and Armenia: The Nagorno-Karabakh Conflict. Washington, Washington, Unites States of America: US Congresional Research Service.

Widjayanto, A. (2022). Pertahanan Udara di Era Geopolitik 5.0. *Lemhannas Seminar* (pp. 1-15). Jakarta: Lemhannas.

Wu, B. (2021). Research on Natural Disaster Early Warning System Based on UAV Technology. *IOP Conference Series: Earth and Environmental Science* (pp. 1-9). San Francisco: ECS.

Zwijnenburg, W. &. (2018). Unmanned Ambitions Security implications of growing proliferation in emerging military drone markets. *PAX*.