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Strategies for Utilizing the Latest Technology of Intelligence Drones for Defense and Security in Indonesia

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Abstract: The primary subject of this research is the role of drones and anti-drone means in the ongoing development of Indonesia's national defense and security. Furthermore, the purpose is to identify the roles of drones and anti-drone means, and assess their potential in future special operations prosecuted by intelligence and security institutions. In addition to acquiring the necessary knowledge about electronics and aerodynamics, researchers must also master observations, interviews, discussions, and document study techniques. After data procurement is concluded, the data are analyzed and validated with information and news facts from open sources. There are two significant roles of drones in operations in the intended locations, namely surveillance and assault roles, in which these two roles are performed by drones with cutting-edge technology to fulfill the operations' goals of attaining real-time military innovations.

Keywords: drone, anti-drone, intelligence, technology, defense, security.

印度尼西亚利用最新情报无人机技术进行国防和安全战略

摘要：本研究的主要主题是无人机和反无人机手段在印度尼西亚国防和安全不断发展中的作用。此外，研究的目的是确定无人机和反无人机手段的作用，并评估它们在未来情报和安全机构实施的特别行动中的潜力。除了掌握必要的电子和空气动力学知识外，研究人员还必须掌握观察、访谈、讨论和文献研究技术。在完成数据采购后，将使用来自公开来源的信息和新闻事实对数据进行分析和验证。无人机在预定地点的行动中有两个重要作用，即监视和攻击，这两个角色由具有尖端技术的无人机执行，以实现实现实时军事创新的行动目标。

关键词：无人机、反无人机、情报、技术、防御、安全。

1. Introduction

The current strategic military development in the Middle East cannot be separated from the ongoing conflict in Syria, in which the conflict is instigated by the emergence of rebellious factions in the country that oppose the Syrian government and the Iraqi Al-Qaeda terrorist organization that sympathizes with the aforementioned groups in opposing Bashar Al-Assad's regime. During its development, the Al-Qaeda group that sympathized with the Syrian rebel factions

founded a new faction, which was then widely known as the Islamic State of Iraq and Syria (ISIS), which separated itself from its parent organization. Furthermore, ISIS declared its version of a global Islamic caliphate, which was then followed by extensive terrorist attacks throughout the world that placed ISIS as a more dangerous terror organization compared to the previous Al-Qaeda [1].

With the emergence of terrorist attacks perpetrated by ISIS, ISIS became a primary military target by the Israeli-and Saudi Arabia-led military coalition, in which military drones were used extensively in the coalition's opening attacks that succeeded in destroying ISIS' pockets of resistance in Syria, Afghanistan, and Iraq. The coalition's ability to destroy its targets was supported extensively by the state-of-the-art detection technology offered by the Allied forces from the United States of America (USA) or Israel.

The country with the closest geographic distance to Syria with significantly advanced detection technology is Israel, which the country is widely known for its export of advanced aerial surveillance drones to dozens of countries around the world. Currently, many militaries around the world can no longer deny a drone's potential as a modern weapon system option for military units, ranging from squad-sized units to national-scale defense [16]. In this context, drones have functioned as the eye in the sky for military commanders responsible for non-combat surveillance and active combat missions [17].

Furthermore, when assessed from a security aspect, drones can be utilized to increase security and law enforcer institutions' surveillance abilities before starting operations to perform arrests on suspected criminals and monitor possible terrorist attacks in strategic locations. In doing so, the involvement of drone technology is tantamount to defense and security institutions responsible for security and stability in strategic locations, as well as a parameter of a sovereign nation's air supremacy over its national airspace.

2. Method

This study used descriptive qualitative research. Qualitative methods were used because this research was directed at obtaining facts [18]. In writing this journal article, in addition to gaining the necessary knowledge about electronics and aerodynamics, researchers must also master observations, interviews, discussions, and document study techniques. After data procurement is complete, the data are analyzed and validated using information and news facts from open sources.

Based on the aforementioned background explanation, the main issue of this study is the future formulation of policies and strategic measures to utilize drones for Indonesia's national defense and security.

2.1. Research Questions

The research questions of this research are as follows:

a. The superiority of the Israeli military in the usage of drones.

b. The possibility of transferring drone technology from Israel to Indonesia, considering both countries' unique geographic locations.

c. The potential of drone technology in forcefully taking down intruder drones from foreign countries.

d. The probable estimation of the required financial costs to build the ability and technology to hack and forcefully take down foreign drones.

e. Drones' potential for Indonesia's national defense and security in the near future.

2.2. Research Scope

The scope of this research extends only to the Indonesian government's attempts to formulate policies and strategic steps for the utilization of drones for national defence and security.

3. Results and Discussion

3.1. Facts

3.1.1. The Superiority of the Israeli Military in the Usage of Drones

Israel has demonstrated remarkable excellence in the use of drones in military contexts. With advanced technology, Israeli military drones are equipped with highly advanced sensors and navigation systems, allowing them to perform various missions with high precision. The flexibility and mobility of drones are important assets, allowing them to be easily deployed in various terrains and conditions. The use of drones in border monitoring is one of Israel's main focuses, enabling constant surveillance of suspicious activity along borders with neighboring countries. In addition, drones are used to conduct high-precision airstrikes against targets that are deemed a threat. The integration of drones with other weapons systems strengthens Israel's military edge, enabling the effective coordination of various military operations. With its commitment to innovation and continuous development, Israel continues to enhance its drone capabilities to meet evolving security challenges.

Israel is geographically surrounded by Arab countries that are unsympathetic to its occupation of Palestine. Israel is geographically located to the west of Jordan and Syria, south of Lebanon, northeast of Egypt, and in the Mediterranean Sea. Israel has an extensive history of warfare with its fellow Arab neighbors (Jordan, Syria, Egypt, etc.), such as the 1967 Six Days' War, the 1973 Yom Kippur War, and the Israel–Palestine conflict (First Intifada, Second Intifada, 2015-present Israeli-Palestine conflict) [2].

Prior to the 1973 Yom Kippur War, Israel was

recorded for the first time using drones in 1971 to perform surveillance missions above the Egyptian airspace. The drone, known as the Ryan Firebee drone, was purchased from the United States (US) and was produced in the same way to create a drone squadron based on Palmachim Airbase, Tel Aviv, Israel. On the other hand, the bait drone used for the surveillance mission was another US-made drone from the Northrop BQM-74 Chukar type, in which both types of drones were then used simultaneously during the 1973 Yom Kippur War by Israel.

In 1974, the Israeli Aerospace Industry (IAI) started producing Scout-type drones that were then used in 1979. In 1981, scout drones were utilized for surveillance missions in Lebanon's airspace against the positions of Syrian-made anti-air defense systems. Throughout 1981 and 1982, Israel also utilized drones in Lebanon's airspace to deduce potential military targets before their destruction by human-controlled combat fighters. During the 1982 Lebanon War, Scout-type and Firebee II-type drones, as well as Chukar-type drones, began to be actively used by the Israeli Defense Forces (IDF) for surveillance and target-seeking missions.

The following is a list of cooperation between the US and Israel in the development of drones for defense purposes:

1. In 1985, a joint production project between the US-based AAI corporation and the Israeli-based IAI corporation resulted in the creation of pioneer-class drones, which were officially used by the Israeli Navy.
2. In 1988, the Israeli IAI managed to produce searcher-type drones that were eventually purchased and used by Indonesia.
3. In January 1991, the US began to utilize pioneer-type drones to guide cannon fires from warships during the Gulf War.

The first recorded instance of Israel using drones to take down persons of interest took place on February 16th, 1991, in which Israeli-owned Scout-type drones were actively used to execute attacks against combatant vehicle convoys in South Lebanon, one of which was boarded by Abbas Al Musawi, a Hezbollah leader. The roles embraced by this type of drone were surveillance and guidance for missile attacks performed by human-manned attack helicopters.

For similar purposes, Israel also utilized drones armed with missiles to assassinate targets in the Gaza Strip during Operation Cast Lead in 2008-2009, resulting in the death of several targets and dozens of others wounded [3]. To this day, developed countries such as the US, the United Kingdom (UK), and Germany actively use Israeli-made drones ranging from Class 1 to class 3-type drones.

The use of Israeli drones by developed countries confirms Israel's position as a leader in the global military drone industry. With this recognition, Israel continues to strengthen cooperative relationships in the development and use of drone technology in allied countries worldwide.

Israel aside, China has the best weapons in the world and is useless unless it is accurately aimed, thus requiring sophisticated intelligence, surveillance, and reconnaissance (ISR) systems to detect and track targets, preferably in as close to real-time as possible. More importantly, at the strategic level, the People's Republic of China (PRC) views modern interstate wars as conflicts between the systems.

China is undertaking extensive efforts on ISR unmanned aerial systems (UAS). Military systems include at least two reported analogs to the American high-altitude, long-endurance (HALE) Global Hawk-Divine Eagle, which went into production before 2018; the Xianglong/Soaring Dragon, which was first deployed in 2018-and several systems for the medium-altitude, long-endurance (MALE) UAS role. The most widely reported MALE systems are Yilong/Wing-loong and BZK-005, roughly similar to (or larger than) the American Predator, and CH-5, roughly equivalent to the American Reaper. The People's Liberation Army Air Force (PLAAF) also recently revealed that the DR-8, a supersonic UAS, was reportedly intended to be used to search for aircraft carriers. In addition, China is deploying a fleet of civilian drones, such as those deployed by the Ministry of Natural Resources for the surveillance of ocean areas, particularly the South China Sea, which the Chinese military is expected to use if and when necessary. Finally, China has tested large unmanned aircraft and at least tested aerostats, both of which can be used as sensor platforms [4].

China's determination to develop AI technology is supported not only by documents but also by practice. The Ministry of National Defense has established research institutes such as the Artificial Intelligence Research Center and the Unmanned Systems Research Center, which focus on the research and development of AI and unmanned systems. The main military think tank, the Academy of Military Science (AMS), has updated its doctrine to address the development of AI technologies. Among all AI technologies, China places top priority on unmanned combat systems, equipment, and other advanced military innovations [5]. Although many current generation drones are largely remotely operated, Chinese officials generally expect military drones and robotics to feature more extensive AI and autonomous capabilities in the future. Chinese weapons manufacturers sell armed drones with significant combat autonomy [6].

3.1.2. Required Drone Technologies for Indonesia's National Defense

Indonesia is an archipelago state located on the equator line and between the Asian and Australian continents. Furthermore, Indonesia is surrounded by two oceans: the Indian and Pacific Oceans, as well as the South China Sea.

Currently, the Indonesian government utilizes communication technology systems of the GSM cellular communication types (including 900, DCS 1800, 3G 2100, and 4G), Wifi 2,4 GHz, 5GHz data link, satellite communications, and Global Positioning System/GPS (L1 1,5 GHz and L2 1,2 GHz).

Unmanned aerial vehicles are known by many names and acronyms throughout history, namely drones, remotely piloted vehicles (RPVs), unmanned aerial vehicles (UAVs), uninhabited combat aerial vehicles (UCAVs), organic aerial vehicles (FVOs), inhabited combat aircraft vehicles (UCAV/S), Remotely Piloted Aircraft (RPA), remely piloted aircraft (RPA), remotely piloted aircraft (RPA), remely piloted aircraft (RPH), remotely piloted helicopters (RPH), aerial robotics, and micro aerial vehicles (MAVs) [7].

Drone technology is a relatively new area of military technology. Military engineers are undertaking developments to combine drones with artificial intelligence to create products that, in some cases, may be comparable to the performance of human reconnaissance teams [19].

Drone technology has become an important aspect of Indonesia's national defense strategy, which includes border security, marine surveillance, forest monitoring, and rapid response to natural disasters. In this context, Indonesia requires drones with reliable capabilities, including sophisticated sensors, accurate navigation systems, and good endurance against diverse environmental conditions. Drones that can operate in extreme weather conditions and difficult terrain are a priority given Indonesia's geographical diversity, including widespread land, sea, and archipelago areas. In addition, integration with advanced communication and reconnaissance systems is required to ensure that drones can provide real-time information to defense authorities. The ability to conduct extensive aerial surveys, detect potential threats, and provide rapid responses to emergency situations is essential to meet Indonesia's national defense needs. With adequate drone technology, Indonesia can enhance its defence capabilities while ensuring national sovereignty and security.

The required drone technologies for Indonesia’s national defense are as follows:

1. Control to class 1 conventional remote drones is set to 430-440 MHZ FHSS (Frequency Hopping Spread Spectrum) with 2,4 GHz and 5 GHz additional settings, whereas the data link communication in L1 and L2 frequencies with 2,4 GHZ signals are used to upload a couple of waypoint data to the flight controller drone.

2. The primary radar/mobile radar is capable of detecting small objects in the airspace within a maximum range of 30 km and a maximum height of 4 km.

3. The drone flight control technology is equipped with GPS, barometers, and gyro/inertial measurement unit (IMU) sensors.

4. Night vision camera technology (thermal sensor-based) can be used in drones.

3.1.3. The Ability or Technology to Forcefully Take Down Foreign Country-Owned Military Drones

In boosting national defense, the following techniques have been proven to reduce foreign drones in cases of territorial breaches.

1) “Man in The Middle”

The frequency signals of the target drone are deliberately overridden to force the drone to depart to a certain location for eventual physical capture. This technique involves changing the frequency signal of the target drone to force the drone to leave a specific location so that it can be physically captured. By changing the frequency signal, the operator can control the movement of the drone and move it to the desired location to be captured or defused. By changing the frequency signal, the operator can direct the drone to a predetermined location, allowing for immediate capture or neutralization of the drone.

2) Interference

One of the strategies used in dealing with foreign drones is to send white-noise signals to the target drone. In this technique, a faction sends a white-noise signal at a frequency with a certain bandwidth and signal strength to the intended foreign drone. This transmitted white noise signal was designed to disrupt the connection between the drone and its original owner. As a result, the drone becomes unstable in its operation and may lose control or be unable to perform the security protocols it normally performs to protect itself from enemy intervention.

By disrupting the connection between a foreign drone and its owner, this white-noise signaling technique prevents the drone from executing certain security protocols that could prevent its capture by an enemy. In other words, white noise signaling inhibits the ability of a drone to respond appropriately to incoming threats, allowing for easier capture or termination of the drone. This technique is an effective strategy for dealing with foreign drones that attempt to violate a country's territory or security, allowing for further actions that can be taken by those responsible for the country's defense and security.

3) GPS Spoofing

The GPS spoofing technique is used to counter foreign drones by sending fake GPS coordinate signals at the L1 and L2 frequencies to the target drone. These fake signals are transmitted with a certain signal strength to be detected by drones that attempt to cross the target area. By receiving these false signals, it is hoped that the drones will be forced to think that they are in a different location. In response, the drones will change their flight path and be forced to depart from the new location that has been determined by the fake

GPS signal. As such, this technique aims to force foreign drones to experience navigational disruptions, which can lead to force takedowns or further actions to capture or disable drones.

The application of this GPS spoofing technique allows the party responsible for the defense and security of the country to change the behavior of foreign drones that cross its territory without permission. By sending false GPS signals, the drone is tricked and forced to change its flight path, which can result in a favorable domino effect to address the threat at hand. Through GPS spoofing, the country can leverage technology to provide a quick and effective response to foreign drones attempting to violate the territory or conduct suspicious activities, thereby enhancing the country's overall defense and security capabilities.

4) Drone Net

The drone netting technique is an effective strategy for responding to the threat of foreign drones using specially designed nets to capture drones. In this process, the target drone is captured by its counterpart drone equipped with a titular net designed to stop its propeller of the target drone. When the net is thrown and catches the propeller of the target drone, the drone experiences a disturbance in its balance and is forced to lose its altitude. This causes the target drone to become unstable during flight and eventually fall to the ground.

The application of the drone netting technique makes it possible to stop a drone physically by disrupting its balance. The drone counterpart can effectively stop the movement of the target drone by using a specially designed net to capture the propellers of the drone. This technique provides an immediate response to foreign drones attempting to cross the territory or conduct suspicious activities, ensuring that the drone cannot continue its mission and reducing the potential threat to national security.

5) Precision Shots

The precision fire technique was used to counter foreign drones by detecting the target drone using an integrated primary radar. This radar makes it possible to accurately detect the presence and movement of a target drone in airspace. Once the target drone is detected, a cannon or projectile launcher capable of precision firing is activated to destroy the target drone in air.

The application of precision fire techniques enables a quick and effective response to foreign drones attempting to cross territory or conduct suspicious activities. Using advanced primary radar, the state can detect target drones with high accuracy, making it possible to take appropriate action against them. The use of cannon launchers or projectiles capable of precision firing ensures that target drones can be destroyed with pinpoint accuracy, thereby reducing the potential threat to national security.

3.1.4. Estimation of Expenses to Forcefully Take Down Foreign Drones

1) Interception

Apart from requiring special hardware, this technique also requires specialized software capable of presenting itself in a manner similar to the virtual controller software of the target drone. Using this similarity, the target's data link connection can be severed. It is estimated that this technique will require more than IDR 20 billion for development and maintenance.

2) Interference

This technique requires several transmitters with different large-scale frequencies and antennas that are directed to the target drone. The white noise signals required for military operations have the following frequencies:

- 430 to 440 MHz UHF.
- 900 MHz GSM cellular.
- 1800 MHz DCS cellular.
- 2100 MHz cellular 3G.
- 4G Cellular.
- 2.4 GHz Wi-Fi.
- 5.8 GHz Datalink.
- L1 1.5 GHz GPS.
- L2 1.2 GHz GPS.
- 1.618 GHz satellite data link/voice.

This technique is estimated to require an IDR of 5 billion for development and maintenance.

3) GPS Spoofing

This technique requires both broadcasting hardware in L1 and L2 frequencies containing fake GPS coordinates and software capable of managing the data on real-time fake coordinates and the target drone's home base coordinates. This technique is estimated to require an IDR of 10 billion for development and maintenance.

4) Drone Net

This technique requires the titular specialized drone nets that will be used to perform a chase by a chaser drone against the target drone, which will result in the forced takedown of the target drone. This technique is estimated to require an IDR of 3 billion for development and maintenance.

5) Precision Shots

This technique requires two systems of integrated weapons, the primary radar system and a projectile launcher system, in which the drone is capable of detecting target drones within a maximum distance of 30 km and performing precision shots at a minimum distance of 500 m. This weapon system is known as the Close-in Weapon System (CIWS). This technique is estimated to require an IDR of 50 billion for development and maintenance.

3.1.5. The Use of Drones for Indonesia's Future Defense and Security Interests

1) The Drones' Single-Role and Multi-Role Potentials

Single-role and multi-role drones have great potential in various fields, including security, defense, environmental monitoring, and infrastructure inspection. Single-role drones, designed for specific purposes, can provide advantages in terms of speed, accuracy, and efficiency for specific tasks. Examples include monitoring drones, which can be used for aerial surveys, border monitoring, and environmental research. On the other hand, multi-role drones, which are equipped with various sensors and technologies, are capable of handling a variety of tasks with greater flexibility. These drones can switch functions from monitoring missions to reconnaissance missions or can even be used for emergency goods delivery in disaster situations. Owing to their wide adaptability, multi-role drones have the potential to optimize the use of resources and improve operational effectiveness in various scenarios. Therefore, the development and utilization of single- and multi-role drones continue to be the focus of expanding capabilities and potential applications in various sectors.

Drones can be utilized for defense policies to counter numerous types of threats, where drones can be utilized for single-role (surveillance) missions or multi-role (surveillance and attack) missions) [20]:

- Military aggression/invasion
- Territorial breach
- Separatism
- Insurgencies/rebellions
- Sea-based security breaches
- Air-based security breaches

2) Utilization of Drones to Deal with Numerous Types of Threats

The use of drones has become an effective strategy for dealing with various types of threats. With their ability to conduct monitoring and reconnaissance in areas that are difficult or dangerous to humans, drones provide efficient solutions. Along national borders, for example, they can be positioned to monitor suspicious movements or illegal activities and provide real-time updates to security officers. Additionally, drones are equipped with sensors that can detect threats such as forest fires or the presence of non-conventional weapons. The speed, mobility, and navigational capabilities of drones make them extremely useful in emergency situations, enabling rapid response and informed decision making in response to threats. As technology continues to evolve, drone utilization in the security context is increasing, helping countries overcome the challenges they face.

The United States government uses drones as weapons in armed conflicts to reduce the risk of death of their soldiers under the pretext that the state (United States) has a responsibility to protect all its citizens, without exception, soldiers sent to armed conflict areas at home or abroad [8].

Drone technology is one of the technologies that can be used as supporting equipment or equipped with weaponry to support military operations. The drone will be equipped with some military technology equipment to increase its ability to become equipment that has the ability to carry out observations and attacks. Military drones are among the latest technologies that have been used in warfare for the past few years, and this technology has increased the effectiveness of warfare. However, the use of drone technology in warfare cannot stand alone, and it is necessary to prepare an ecosystem of products that can be integrated to support each other [9].

The primary role of drones is to emphasize drone usage for single-role (surveillance) missions to support the implementation of community security and order *(kamtibmas)* and the physical arrest of crime perpetrators, along with the necessary pieces of evidence for court purposes.

- Sea-based security breaches
- Threats against national vital objects *(obvitnas)*
- Terrorism threats
- Communal conflict threats
- Conventional crime threats
- Extraordinary crime threats

3) Aerial Strategies and Superiority

- Strategy

The emplacement of drone squadrons in several selected locations along the border was adjusted based on the nation's defence strategy. Budget allocations are adjusted based on the drones required for the *kamtibmas* function. An example of this strategy can be seen in the Brazilian government's attempt to purchase Hermes 900 from Israel to upgrade the security of Brazilian cities.

- Surveillance

Drones capable of aerial surveillance missions can be specifically deployed to certain locations within a specific timeframe, in which they can be deployed to perform the opening stages of deadly operations against the locations of potential terrorists.

Furthermore, surveillance missions performed by aerial drones abide by the following intelligence work cycle (Operation Planning, Data Gathering, Data Analysis, Result Presentation, and Intelligence Usage).

- Air Superiority

Drones have the full potential to perform full surveillance over Indonesia's airspace, ranging from the detection phase to the neutralization phase against all possible threats.

3.2. Analysis

3.2.1. The Superiority of the IDF in the Usage of Military Drones

Drones are unmanned aircraft controlled by a pilot

that is either separate from the vehicle or follows a pre-programmed mission. There are many types of military drones, but they are generally divided into two categories: those used for reconnaissance, surveillance, and intelligence purposes (in military terms, known as intelligence, surveillance, target acquisition, and reconnaissance or ISTAR) [10].

The Israel Defense Forces (IDF) have shown significant excellence in the use of military drones, which have become one of the main assets in their defense strategy. One of the advantages of IDF is its ability to effectively integrate drones with their air and ground defense systems. Israeli military drones are equipped with advanced technologies, such as sensors, cameras, and navigation systems, that enable precision monitoring and reconnaissance. They are widely used for border monitoring, tactical reconnaissance, and quick and effective air strikes. The IDF is also renowned for using armed drones capable of carrying out precision strikes against targets deemed a threat, thus minimizing the risk to their military personnel. Israel has strong expertise in the development and production of military drones, with companies such as Israel Aerospace Industries (IAI) and Elbit Systems being leaders in the industry. With a combination of advanced technical capabilities, good integration with existing defense systems, and constant innovation in drone development, the IDF continues to strengthen its position as a leader in the use of military drones for national defense and security interests [11].

The IDF plays an essential role in defending Israel's national sovereignty considering the country's lack of direct geographical allies. As a result, the IDF is consistently demanded to be innovative and initiative in commencing military innovations against all types of military threats. Based on the country's history, before the 1973 Tom Kippur War, Israel had already initiated national programs to develop aerial surveillance means, such as the purchase of US-made Firebee drones in 1971. The IDF's further programs to develop firebee-based drone squadrons after 1971 were seen as an attempt to reverse engineer the drone's technology to update Israel's existing drone technology.

The development of Israel's drone technology mastery made further progress through the purchase of chukar-type drones from the US in 1973, in which these drones were used as bait to detect the Egyptian military's response when the drones were deployed over the Egyptian airspace.

After the purchase of chukar-type drones, another purchase was made in 1974, as seen in the purchase of US-made Scout drones. Israel's pursuit of drone technology resulted in technology sharing in the joint production scheme of pioneer-type drones between the US and Israel in 1985. Pioneer-type drones were then succeeded by Searcher-type drones in 2000, in which the drones were capable of flying for a distance of hundreds of kilometers.

Israel's attempt to develop multirole drones continued until 2004, when reports began to emerge about the activities of multirole drones for surveillance and attack missions against two prominent Palestinian Islamic jihadists, Ziad Abu Mustafa and Omar Abu Mustafa. In 2005, it was confirmed that Israel managed to gain ownership of Heron 1 multirole drones made by the Israel Aerospace Industry (IAI) for surveillance and attack missions.

3.2.2. Possible Transfer of Drone Technology from Israel to Indonesia

The need for the transfer of communication technology that includes signaling, jamming, and data link technologies is becoming tantamount to the development of multirole drones for different missions (interception, interference, and spoofing). From this possible transfer of technology, Indonesian engineers and scientists are expected to master the necessary abilities to develop electronic transmissions with specific frequency characteristics, either encrypted or open-source, for missions at different aerial altitudes.

As for jamming and data link technologies, the mastery of these technologies must be grasped by Indonesian scientists to develop proper countermeasures against foreign drones in Indonesia's airspace.

Furthermore, there is an urgent need for the transfer of technologies related to the development and production of primary radars to detect foreign drones that may operate within Indonesia's airspace. For this purpose, the Indonesian military will require sophisticated and modern radars with the ability to detect small-sized objects (including drones) that may elude the radars of previous generations owned by the Indonesian military.

Similarly, there is a need for technology transfer related to the development and production of chips and integrated circuit hardware flight control drones that are outfitted with GPS sensors, barometer sensors, and gyro/inertial measurement unit (IMU) sensors. In this development, previous fixed-wing and rotary-wing drone designs powered with either batteries or liquid fuels will need to be further developed to accommodate the upgrading of their abilities.

Equally urgent is the emerging need for the transfer of night vision camera technology (including thermal sensors) for drones. The need for these NV cameras is becoming a challenge as countries struggle to procure them. However, if properly procured, the availability of these NV cameras will greatly help drones detect human presence in normally unseen locations despite possible natural visual obstructions.

As a sensitive political and security aspect, the transfer of drone technology from Israel to Indonesia could involve several complex factors. The political relationship between the two countries, as well as their respective foreign and security policies, affects the

likelihood of such a transfer.

Israel is known as a manufacturer of advanced and innovative drones, with companies such as Israel Aerospace Industries (IAI) and Elbit Systems being leaders in the industry. However, relations between Israel and Indonesia have long been strained, mainly due to the Palestinian-Israeli conflict and Indonesia's stance in favor of Palestinian independence.

Nonetheless, in recent years, there have been signs of improving relations between Israel and several Muslim countries, including Indonesia, especially in terms of security and economic cooperation. Some Arab countries have established diplomatic relations with Israel. However, the transfer of drone technology from Israel to Indonesia is likely to be a highly sensitive issue in Indonesia, and could generate political and public controversy.

Indonesia's foreign policy also tends to be independent and less inclined towards the interests of certain countries. Nonetheless, Indonesia needs drone technology for various purposes, including border surveillance, environmental monitoring, and other internal security purposes. The possibility of drone technology transfer from Israel to Indonesia largely depends on changes in regional political and security dynamics as well as the policies of the Indonesian government itself.

3.2.3. The Ability or Technology to Forcefully Take Down Foreign Country-Owned Military Drones

1) Interception

This technique can only be performed if the targeted drone is located by tracing the drone's uplink signal to a satellite or through the primary radars in a certain strategic location. Then, the targeted drone is overridden by overtaking the drone's control signal. Once the signal intended to overtake the drone is sent, the original owner of the drone loses control over the drone as the drone has been "hand-shaken" (overridden) by the other faction.

2) Interference

This technique can be performed with a no-fly zone location model or a model that relies on the broadcasting antenna to a located enemy drone. Once the target drone receives the "White Noise" signal, the drone will refer to a series of default security protocols as it loses its original GPS coordinate signals. Finally, the drone slowly descends to the ground or returns to its original home base.

3) GPS Spoofing

GPS spoofing can be performed when the targeted drone is located, after which the drone receives a "spoof" GPS satellite signal that can be perceived as a signal that relays new orders from its original owners. At this point, the drone departed to a new location, as indicated by the signal. Furthermore, the spoofed signal can have varied barometer/height-based data and fake inertial (gyro) values, with the intention of causing the drone to lose altitude and fall to the ground.

4) Drone Net

Drone nets can be deployed by specialized drones that can launch a titular net for the targeted drone. Upon launching the net, the net can interrupt the propeller movements of the targeted drone, which results in the targeted drone losing altitude and becoming vulnerable to recovery by the opposing faction.

5) Precision Shots

A combination of radar and cannon/projectile-based weapons can launch precision shots against drones, and this technique has been widely used in developed countries. Furthermore, this weapon system combination can also reduce enemy missiles, as seen in Israel's Iron Dome weapon systems [12].

3.2.4. Estimation of Costs to Take Down Enemy Drones

1) Interception

This technique requires more than IDR 20 billion to finance homing drones and signaling systems. Both systems are necessary to localize targeted drones and trigger the targeted drone to switch sides using the drone handshake method.

2) Interference

This technique requires approximately IDR billion to build a white noise signal broadcaster in certain signal frequencies, such as

- 430 to 440 MHz UHF.
- 900 MHz GSM cellular.
- DCS 1800 MHz cellular.
- 3G 2100 MHz cellular.
- 4G cellular.
- 2.4 GHz Wifi.
- 5.8 GHz data link.
- L1 1.5 GHz GPS.
- L2 1.2 GHz GPS.
- 1.618 GHz data link/voice satellite.

3) GPS Spoofing

The GPS spoofing technique requires an IDR of approximately 10 billion, in which a broadcasting module capable of creating spoofed GPS satellite signals is produced en masse. The signal can broadcast faked coordinate signals in certain locations, either at L1 or L2 frequencies, in real time. Moreover, fake terrestrial coordinate locations will be broadcasted to further disrupt the GPS sensors of the targeted drone.

4) Drone Net

Drone net research and production are estimated to spend approximately IDR 3 billion, and these specialized drone nets will be deployed to missions in drones that are capable of carrying and deploying these nets without the risks of having the nets ensnaring the carrier drones instead.

5) Precision Shots

The production of precision shot weapon systems is

estimated to spend more than IDR 50 billion, as the integration of the two different systems would have to be maximized using this budget estimation for maximum performance in shooting down targeted drones.

3.2.5. The Use of Drones for the Future of Indonesia's National Defense and Security

Presidential Decree No. 8 of 2021 concerning the General Policy of State Defense for 2020-2024 explains the Policy on Technology Development and Defense Industry, where defense technology development is directed to one of them mastering the key technologies of the Unmanned Aerial Vehicle priority program. Several ministries and institutions have also issued regulations and policies related to this technology, such as Presidential Decree No. 38/2018 of the National Research Master Plan 2017-2045 (Appendix Table 4, 6. Integration of Defense and Security Research Focus; Unmanned Aircraft >200 km Range), Minister of Defense Regulation No. 26/2016 on unmanned aircraft systems for defense and security tasks, Minister of Transportation Regulation No. PM 37/2020 on the Operation of Unmanned Aircraft in the Airspace Served by Indonesia, and Government Regulation No. 14/2015 on the National Defense Industrial Development Master Plan (2015-2025) section VI.b [13].

The use of drones has a great potential to become one of the main pillars of Indonesia's national defense and security. With geographical diversity covering thousands of islands and vast border areas, drones can be a highly effective tool for border monitoring, marine surveillance, and law enforcement across the country. In addition, drones can be used in rapid response to natural disasters, such as forest fire monitoring, search and rescue, and humanitarian aid distribution. Investing in the development and utilization of advanced drones will help Indonesia enhance its defense and security capabilities, allow for faster and more effective responses to security challenges, and strengthen its national sovereignty. By continuing to develop and utilize drone technology, Indonesia can strengthen its position as a country capable of addressing threats and maintaining stability and security in the region.

1) Multirole Drones

The full analysis of Indonesia's use of drones for defense must be considered in the production of multirole drones capable of surveillance and attack missions. Multipurpose drones offer flexibility and excellence in meeting a variety of defence needs, ranging from surveillance of the territory to precision strikes against targets deemed as threats. Equipped with advanced sensors and accurate navigation systems, multi-role drones can provide defense authorities with a comprehensive picture of the security situation on the ground [21]. Moreover, their ability to switch roles from surveillance to attack missions quickly and efficiently makes them an invaluable asset for addressing a variety of complex security challenges. By utilizing locally produced multi-role drones, Indonesia can enhance its defense and security capabilities, ensure national sovereignty, and confront threats with faster and more effective responses. This analysis must be in line with the possible threats that multirole drones may face in operations in which the threat spectrum covers the following:

- Aggression-based military threat
- Territorial breach-based military threat
- Separatism-based military threat
- Insurgency-based military threat
- Sea security breaches-based military threat
- Aerial security breaches-based military threat.

2) Single-role Drones

The analysis of the use of drones for security purposes should include the potential use of single-role drones for surveillance purposes. Single-role drones, designed for specific purposes, such as monitoring or reconnaissance, have advantages in terms of speed, accuracy, and efficiency in surveillance tasks. They can be deployed to monitor areas that are difficult or dangerous for humans, such as borders or remote areas, and provide security officers with a comprehensive picture of the situation on the ground [14]. In addition, single-role drones can be used for environmental surveillance missions, such as forest or water monitoring, which allows for the early detection of illegal activities or suspicious environmental changes. With their wide adaptability, single-role drones have the potential to become invaluable assets in supporting national security surveillance efforts, enabling a rapid response to a variety of emerging security challenges. These surveillance drones will function as aerial overwatches for *kamtibmas* maintenance and law enforcement tasks, as these tasks will require the use of drones for the maximum success of these operations while maintaining the human rights aspect in arresting potential suspects. Single-role drones can be deployed to deal with the following *kamtibmas* threats.

Threats to Territorial Waters

Threats of sabotage in *obvitnas* instances

- Terrorism threats

Threats to Communal Conflicts

- Threats to conventional crimes
- Threats to extraordinary crimes .

3) Strategies for Aerial Surveillance and Superiority

- Strategy Analysis

Currently, the need for drones must be adjusted according to the locations of potential threat sources to ensure that the available drones are capable of dealing with terrain, weather, and adversary challenges. The analysis of threat sources is based on the enemy's potential deployment of military forces in Indonesia's terrestrial or maritime borders, such as the South China Sea. Upon assessing the capabilities of the enemy, the drone waypoint and flight routes can be adjusted

further and turned into reference materials for the formation of the national defense policy.

- *Surveillance Analysis*

Surveillance drones must be capable of providing real-time data based on telemetry data, such as location coordinates, wind speed, and brightness/zoom level of potential human and material targets, as well as the drone's flight duration at the chosen location.

- *Aerial Superiority Analysis*

The emplacement of drones in strategic locations can increase the required response time against instances of airspace violation and bring more tangible benefits for the Indonesian government's diplomatic policies, both nationally and in the region.

3.3. Implementation of Strategies for the Use of Drones

3.3.1. Categorization of Drones

In building its drone force for national defense and security, the Indonesian government needs to categorize drones based on the following payload category used by the IDF in categorizing their drones:

- Class 1 drone (capable of carrying a payload weighing 150 kg)
- Class 2 drone (capable of carrying a payload weighing 150-600 kg)
- Class 3 drone (capable of carrying a payload weighing above 600 kg)

Class 1 drones are further categorized into micro drones, mini drones, and small drones. The following is information on the total weight (without payload):

- Micro drone (<2 kg)
- Mini drone (2-20 kg)
- Small drone (>20 kg)

Finally, drones can be categorized based on their flight altitude, as seen in the following categorization:

- Maximum altitude of 3 km (10.000 feet)
- Maximum altitude of more than 3 km (10.000 feet)
- Maximum altitude of more than 4.5 km (15.000 feet)
- Maximum altitude of more than 6 km (20.000 feet)

3.3.2. Potential Transfer of Drone Technology from Israel to Indonesia

1) Transfer of communication technology such as signaling, jamming, and data link technologies.

2) Transfer of technology for the development and production of primary radars.

3) Transfer of chip/integrated circuit hardware for drone flight controls equipped with GPS sensors, barometer sensors, and gyro/IMU (Inertial measurement unit) sensors. The transfer will also include the designs of fixed-wing and rotary-wing drones, along with their battery or fuel technologies.

4) Transfer of night vision camera technology (e.g., thermal sensors) for drone surveillance tasks.

All these plans for the transfer of technology for the production of Indonesia's homegrown multirole and single-role drones are tantamount to implementation by gaining the transfer of technology from Israel. In this context, the transfer can be realized by contacting and cooperating with Israel's drone manufacturers, such as the IAI Israel Aerospace Industry, ADS Aeronautics Defense System, Aero Tactix Ltd, Blue Bird Aero System Ltd, Elbit Systems Ltd, Emit Aviation Consult, Innocon, Steadicopter, and Top I Vision.

Transfer of technology from the aforementioned manufacturers by the Indonesian government from Israel is necessary for future reverse engineering, as exemplified by the Israeli government's successful attempt to reverse engineer the US-made Firebee surveillance drone and Chukar bait drone in 1971.

3.3.3. List of Potential Partner Countries for Learning Anti-Drone Measures

1) Interception (US and Germany)
2) Interference (US, China, and Germany)
3) GPS Spoofing (Russia and China)
4) Drone Net (China)
5) Precision Shots (US and France)

3.3.4. Estimation of Costs to Take Down Enemy Drones

Based on current projections, the estimated time needed for the purchase of each drone type for different types of threats is estimated to range from six months to one or two years.

Beyond estimating the required time to purchase each type of drone, the government will also need to create a list of capable Indonesian scientists to fully commit to the project of transferring drone technology from Israel. In this regard, scientists are required to possess practical research and developmental skills to determine the necessary equipment and methods for forcefully taking down enemy drones during peace or war under the government's full funding.

Lastly, the government is also required to estimate the funding needed to purchase Israeli-made drones by inviting representatives of Israeli drone manufacturers to Jakarta (Indonesia) for demonstration and assessment of drone quality before purchase.

3.3.5. The Use of Drones for the Future of Indonesia's National Defense and Security

The use of drones has great potential as a key to the future of Indonesia's national defense and security. Given the geographical diversity and complexity of the security challenges faced, drones can be an invaluable asset in strengthening Indonesia's defense capabilities. In this context, the use of drones for border, marine, and environmental monitoring can provide a comprehensive picture of the security situation across

the country. In addition, drones can be used in rapid response to natural disasters, search and rescue, and the distribution of humanitarian aid, all of which are important aspects of national security. With investment in the development of advanced drone technology and supportive policies, Indonesia can harness the potential of drones to enhance their defense and national security responsiveness. Through effective and planned utilization, drones can be powerful tools for maintaining the country's sovereignty and ensuring security stability throughout Indonesia.

Drone surveillance that produces aerial photos has important benefits for Indonesia's defense. Aerial photos produced by drones provide an in-depth understanding of the geographical conditions, infrastructure, and human activities in various regions, including borders and remote areas. This provides Indonesian defense authorities with invaluable information for strategic decision-making, operational planning, and the early detection of potential security threats. Using aerial photos from drones, authorities can monitor suspicious movements and activities at the border, including the smuggling of prohibited goods, illegal infiltration, or armed group activities. In addition, aerial photo monitoring allows for the early detection of forest fires, illegal logging, and other illegal activities that can damage the environment and national security.

Aerial photography is an image recorded from the air to obtain an image of a part of the earth's surface using an airplane vehicle with a certain height and a camera as a recording device [15].

To fully commit to the plans of turning drones into essential equipment for enforcing national defense and security, the Indonesian government is expected to prioritize certain Indonesian National Police (POLRI)/Indonesian National Armed Forces (TNI) units that will receive drones based on their deployment, drone flight, and attack capabilities. Under this prioritization, these POLRI and TNI units may receive a significant boost in their capability of sufficiently dealing with possible defense and security threats in their respective locations.

In dealing with possible defense and security threats from foreign actors in Indonesia’s airspace, aside from the purchase and transfer of drone technology from Israel, the Indonesian government is expected to prioritize potential threats within its territory. Upon determining threat levels, only the government can deploy drones (either purchased or domestically produced) based on the severity of potential threats in different locations.

Furthermore, in determining the severity of each threat, it is estimated that drones will greatly assist the Indonesian government in analyzing certain locations. This analysis will assist the government in determining the potential threats that may emerge in these locations [9]. As these threats may become detrimental to Indonesia’s defense and security, proper and continuous training for members of the POLRI and TNI is necessary to boost their skills and confidence in properly dealing with all types of threats, as many of them will be posted in the available Command Posts in different locations across Indonesia.

4. Conclusion

After years of domestic conflict, the Israeli government has made significant progress in enhancing its defense industrial capacity, especially in the development of military drones. The collaboration between Israel and the United States in acquiring and developing military drones, driven by strong political ties between the two countries, has proven successful in combating global terrorist groups. Given Israel's excellence in drone production for national defense and security, this study suggests that the Indonesian government should consider expanding cooperation with Israel. This consideration is based on the two countries' unique geostrategic locations in Southeast Asia and the Middle East, as well as Indonesia's ability to reverse engineer drone technology acquired from abroad. Indonesia can significantly enhance its national defense and security capabilities by developing an advanced national drone fleet. However, to effectively counter foreign drones, the Indonesian government needs to allocate sufficient funds for the development of technologies and methods of countering foreign drones, such as interception, interference, GPS spoofing, drone nets, and precision fires. By doing so, Indonesia will be better prepared to deal with various threats that may arise both in times of peace and war.

The implications of this study are significant. First, it highlights the development of Israel's defense industry, particularly in the development of military drones, after years of domestic conflict. This shows that the experience of conflict can be an impetus for technological advancement and a country's defence industry. Second, the collaboration between Israel and the United States in the development and improvement of military drones highlights the importance of international cooperation in addressing global security threats, especially in fighting terrorist groups, such as Al-Qaeda and ISIS.

5. Recommendations

To fully develop its national drone fleet, it is highly advisable for the Indonesian government to cooperate with Israeli drone manufacturers using systematic purchasing patterns. In this procurement process, technology transfer is deemed necessary for Indonesia’s future national drone development. Upon the acquisition and deployment of these drones, it is estimated that the Indonesian government's capacity to address various threats to its national sovereignty can be significantly enhanced through the coordination of local manufacturers and substantial government

funding.

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