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Optimization of Unmanned Aerial Vehicle (UAV) Development in the Defense Industry Related to Future Defense and Security Needs

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Abstract

Increasingly sophisticated technological innovations encourage Indonesia to continue to modernize defense equipment and all things that support military activities. One of them is ownership of unmanned aircraft (PTTA) or drones. This unmanned aircraft in the military world is called the Unmanned Aerial Vehicle (UAV) which functions as an air reconnaissance machine as well as a weapon. This article discusses in detail the UAV regulations and their development agencies in Indonesia and the future needs of the Defense and Security Agency by using a descriptive qualitative approach. UAV technology can be used for environmental and security monitoring, weather monitoring, meteorological research, agriculture, mineral exploration, and mining even for military purposes. In Indonesia, the development of UAVs must be optimized by utilizing the Defense Industry that is owned regarding the needs of defense and security tools in the future.

Keywords
optimization of unmanned aerial vehicle (UAV); development; defense

I. Introduction

Defense is all efforts to maintain state sovereignty, territorial integrity, and state security from threats and obstacles to the state and its integrity. This understanding implies the importance of defense as one of the key elements to maintain the existence of the state. Today, the defense has experienced rapid development, including concepts and technology in the sense of defense itself. This condition is the answer to the challenges of the development of modern technology and information disclosure. Of course, Indonesia as a large country needs to meet these defense challenges.

In today's global landscape, threats to state sovereignty are growing along with technological developments. Defense technology is still considered representative of today because it is always driven by deterrence capabilities to be able to respond to threats and respond to threats that continue to grow. Therefore, defense products have always been at the forefront of technology. In that context, a country with a strong defense industry is considered to have a strategic advantage in the world order. This condition means that Indonesia needs a defense support system and weapons system that must be able to deal with various potential threats that will arise.

Technological advances and the defense industry increased after the Cold War due to increasingly competitive markets, which prompted the defense industry to try to attract consumers for their products. This condition cannot be separated from the two things. First, liberalization has occurred in the defense industry, especially in western countries. Second,

the emergence of major changes in the scope of the war, presenting the application of technology combined with fundamental changes in the doctrine, operations, and concepts of military organization, which are related to the personality and leadership style of the military. This change is known as Revolution in Military Affairs (RMA). Therefore, major countries are trying to develop weapons as a product of their industrial defense with an emphasis on the application of advanced technology (Sloan, 2008).

These two conditions led to the birth of many sophisticated weapons that were produced and used by many countries, especially developed countries. Various advanced technologies have been applied to meet the needs of consumers who want weapons capable of facing new threats that are emerging in their country.

The development of technology in the modern era has brought many advantages in every human need, including in the fields of information, communication, transportation, and other fields. Various technologies and devices have been created to help people work more efficiently, faster, and more easily (Syaf, et al., 2016). Currently, weapon technology with stealth capabilities and unmanned weapons such as the UAV is the mainstay of the defense industry in developed countries (Hayward, 200).

UAV is one of the technological developments that can be applied to several photographic applications in several fields such as industry, disaster monitoring, agriculture, and many other applications depending on the purpose of the technology used. As time goes by, the development of technology in this world is increasing. The development of technology and demand for drones is currently also increasing. For various reasons, ranging from military purposes to civilian uses, many studies have been developed by various countries to produce UAVs that can fly with reliable maneuverability and high accuracy.

Increasingly sophisticated technological innovations encourage Indonesia to continue to modernize defense equipment and everything that supports military operations. One of them is ownership of unmanned aircraft. Unmanned Aircraft also known as Unmanned Aerial Vehicle or drones are gaining popularity among the public thanks to a large number of photos and video footage from photography enthusiasts. At first, drones were created for military needs, this unmanned aircraft in the military world is called the UAV, which is a flying machine that functions remotely by the pilot or can control itself, can be reused, and can carry cargo. both weapons and other cargo.

This reconnaissance aircraft as a UAV is the fastest growing technology in the world. UAVs have been developed for various purposes such as detecting civilians and the military to monitor the area. This drone is used in various fields, such as geography, photography, videography, and of course massive use in the military field. In the military world, the AUV took over the role as an aerial survey tool, not only used for warfare but also security and traffic control.

Until 2009, the development of each country towards drone technology was very rapid. Since late 1996, the Australian government has begun to encourage the academic, telecommunications, and remote sensing communities to increase research on drone technology and its potential applications. The results of this activity demonstrate advanced capabilities in flight control system design and systems as well as UAV performance seen in test and simulated flights. Additional developments in UAV dynamics and control continue to this day.

The UK, France, and Germany continue to dominate Europe in drone development and production, with more than 90 different aircraft variants from around 30 manufacturers. Several German MAV series developments have combined UAVs with submarines to extend surveillance range while remaining underwater.

No less important is the development of drone technology in countries in the Middle East region, such as Iran, Israel, Turkey. In 2007, Iranian officials accused multiple claims of multiple flights with UAVs and reconnaissance over US ships in the Persian Gulf and the development of a stealth-type drone with a long range of up to 700 km.

The countries that have developed the most drone technology are Russia and the United States. In recent years, the drone program in Russia has doubled. Efforts to develop Predator-class drones for various military and civilian purposes have prompted the Russian state to expand its share of the highly lucrative export market. The United States itself has created a very famous type of UAV called the Global Hawk and The Predator as a major government project in UAV development. The US government has also developed a UAV development plan until 2025 to develop unmanned aircraft technology for various purposes (Defense, 2001).

In addition, there have been several cases of terrorism using drones, for example, the attack of two explosive drones in August 2018 on the Venezuelan President, Maduro, who was giving a speech on the 81st anniversary of the national army. The incident was allegedly carried out by right-wing opposition groups because they lost the presidential election. Although Maduro's target was safe at the time, seven soldiers were injured in a drone explosion that occurred in the Caracas region. Terrorist attacks using drones occur not only against VVIP officials at the level of the president or head of state but also lead to vital national objects of a country. Some of them were attacks that occurred at the oil facilities of the Aramco Company, Saudi Arabia, resulting in fires at the two facilities in Khurais and Abqaiq (Firmansyah & Puspitasari, 2021).

II. Research Methods

This article is the result of research using a descriptive qualitative approach as the main writing approach. Descriptive qualitative research is a research method that is usually used to examine natural objective conditions where the researcher acts as a key instrument (Sugiyono, 2008). The data used in this research is secondary data in the form of a literature study. The literature study was carried out by searching for various literature that matched the discussion on Optimizing the Development of Unmanned Aerial Vehicle (UAV) in the Defense Industry Related to Future Defense and Security Needs.

This search process begins with an online search for journals in various journal databases and websites through Google and Google Scholar search engines. Apart from that, offline searches were also carried out on books, printed journals, and policy documents. This search focused on literature published in 2000-2021. The results of the research are then reduced and taken that are in line with the research topic as reference material in this writing.

III. Discussion

3.1 Unmanned Aerial Vehicle (UAV)

Unmanned Aerial Vehicle (UAV), also known as Unmanned Aircraft or Drones, is an aircraft that does not use a crew and its flight is controlled remotely. UAV works with the pilot outside the aircraft, while the aircraft operates automatically on the orders of the aircraft operator which is a visualization of the UAV aircraft. It is an aircraft that can carry out missions independently using various computer sensors, propulsion, and handling systems.

UAVs also have many uses, both for military and civilian purposes. In the civilian world, drones are widely used in business, industry, and logistics. In the industrial world, drones have been applied in various services such as infrastructure monitoring, package

delivery, forest fire fighting, exploration of mining materials, mapping of agricultural areas, and mapping of industrial areas. While in the military world, UAVs are used for reconnaissance, unmanned combat aircraft, surveillance, inspections, surveys, search and rescue, mapping, and others. Some flight missions require effective equipment to minimize risks to flight personnel. UAV are potentially quite effective to overcome these difficulties at lower risk and cost.

UUAV technology can be controlled remotely with radio waves. The UAV system is run by an automatic system with Ground Positioning System (GPS) navigation guidance integrated into the UAV, ground station with flight path planning software, and telemetry using the laws of aerodynamics to lift itself. (Suryanta, 2014)

Based on the type, there are two types of unmanned aircraft, namely multi-copter and fixed-wing. Fixed-wing has a shape like a conventional airplane equipped with wings. While the multicopter does not use wings, it only uses the rotation of the propeller to fly.

Figure 1. *UAV Type Fixed Wing*

Figure 2. *UAV Type Multicopter*

In general, a UAV system is made up of several interacting parts, such as an aircraft and an earth control station.

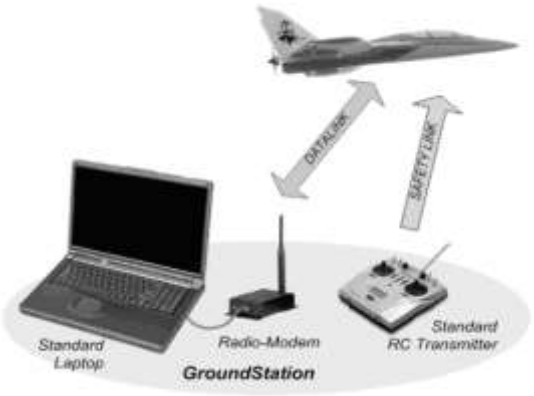

Figure 3. *General UAV circuit, consisting of Laptop/Smartphone, Radio/Modem, and Remote Control*

The use of drones for different civil and military purposes will have different specifications. Therefore, the unmanned aircraft will consist of many components according to the needs that will affect the size of the aircraft. It will also affect flight time, flight distance, and flight altitude.

The quality and resolution of the image produced by a drone depend on the altitude at which it is flying, as well as the type and characteristics of the sensor. For example, a drone flying 215m above the ground, equipped with a digital camera commonly used by the public, can take pictures with a pixel resolution of about 6cm. While the Near Infrared (NIR) camera has a sound length of 8.5 mm, a flight altitude of 2,500 feet (H" 762 meters above ground level, the resulting image has a pixel resolution of about 0.5 meters). Detection devices on UAVs include video cameras, multispectral and hyperspectral sensors, heat detectors, synthetic aperture radar (SAR), and atmospheric sensing. (Rizatus, 2011)

Currently, UAV has developed very rapidly and is used in various operations. Here are some examples of activities using UAV (Syahlavida, Ali, Saragih, & Deksino, 2002)

1. Remote sensing, such as monitoring the power grid, mapping the area, observing the geological condition of the area, and monitoring agricultural land.
2. Responding to disasters, such as monitoring damage from floods and monitoring forest fires.
3. Legal supervision, such as site security patrols, traffic monitoring, coastal and marine patrols, and borders.
4. Search and rescue victims in hard-to-reach areas.
5. Transport travel, such as for small cargo, for large cargo, and for passengers.
6. Permanent or temporary means of communication and also to transfer broadcasts such as TV and radio shows.
7. Transporting and delivering cargo, such as transporting water to extinguish fires or transporting chemicals for factory maintenance.
8. Shooting for purposes in border areas, stealing fish and drugs, and spreading terrorism.

UAVs can fly in all directions, without a special runway like airplanes in general. The ground used can be a trail or even grassy terrain. Some types of UAVs can move both vertically and horizontally. There are advantages and limitations to using a UAV. The advantages of UAV: (1) Can be used relatively quickly anywhere, and can be done iteratively to detect changes, where the temporal image can be obtained in real terms; (2) Can fly low so that high-resolution images can be produced; (3) Lower aircraft maintenance and image acquisition costs, resulting in lower operating costs; (4) Wide and varied applications; and (5) No pilot required, so it is relatively safe; (6) Can be developed because the cost is still

relatively lower than launching a satellite or manned aircraft. While the limitations of UAV such as: (1) The initial investment cost is relatively expensive (depending on the size and complexity of the UAV); (2) Training and regulatory requirements for flying a UAV in the air; (3) Limited image sensor capabilities; (4) Image processing may be more difficult if the stability of the aircraft is poor due to the use of poor quality sensors. (Rizatus, 2011)

3.2 Regulation Regarding AUV in Indonesia

Along with the increasing number of drone users, special rules are needed to regulate drone flights so that they are not operated arbitrarily. The Indonesian government has issued a drone flight law through the Ministry of Transportation. Special rules regarding the operation of unmanned aircraft, following the regulations of the Minister of Transportation of the Republic of Indonesia Number 37 of 2020 concerning the Operation of Unmanned Aircraft in Air Spaces Served by Indonesia. These regulations are intended to make the operation of unmanned aircraft in the airspace served by Indonesia more orderly, clear, and precise; and supervision in the operation of unmanned air can be carried out in an integrated manner to maintain the security of air space and flight safety.

The operation of unmanned aircraft in Controlled Airspace must obtain approval from the Director-General of aircraft with a maximum height of 120 m or 400 feet, more than that must be approved by the Director-General of the Ministry of Civil Aviation (Kemenhub). In addition, the regulation also prohibits the use of drones in the operational area of the Aviation Operations Safety Area (KKOP), including airports that do not have a KKOP, with the approval of the Director-General, Operations within a radius of 5.5 km or 3 Nautical (NM). from heliports outside KKOP, must obtain approval from the General Manager. After that, Prohibited & Restricted Area; Restricted areas must have the approval of the CEO and local government. Placement on drones is based on aviation security interests following the Duties and Functions of the Department of Transportation, while security interests have not been determined because most of the regulations of the Department of Transportation are part of the Federal Aviation Administration (FAA provisions).

In addition, it is also important to know the rules when taking pictures thanks to the camera equipped with the drone. This article deals specifically with photography of people and other objects. For photos of people, refer to law number 28 of 2014 concerning Copyright (UUHC), in particular articles 12 to 15 which regulate the economic rights of portrait photos.

Other rules regarding the use of drones are also regulated in Government Regulation no. 4. the Year 2018 concerning the Safety of the Airspace of the Republic of Indonesia. Article 1 paragraph 1 number 19 specifically refers to the definition of unmanned aircraft which can be subject to the provisions of this article. Regarding the crackdown on drones that enter the area, Indonesia also stipulates in Article 27, paragraph 4, and paragraph 5, which regulates the action of drones that enter prohibited airspace and airspace. (Firmansyah & Puspitasari, 2021)

Currently, no regulations are governing the use of UAVs from the point of view of national safety, none of which requires UAV users to document assets. The absence of regulations governing the use of UAVs in Indonesia leads to the emergence of loopholes in the misuse of UAVs for acts of terrorism. For this reason, the DPR must encourage the government to make regulations regarding the use of UAVs as a whole. In addition, a UAV ownership record is required. In addition to making it easier to track UAV abuse, this record is likely to be a source of income for the country. It also needs to be strengthened with licensing requirements such as those applied by Australia, the Kingdom of Saudi Arabia, and the United Arab Emirates (Ulfa , Riyono , & Christianingrum, 2021).

3.3 Defense Industry Optimization UAV Developer

The Defense Industry is one of the most attractive strategic aspects for countries in the international bloc, including Indonesia. Countries tend to look for ways to develop defense industries to fully utilize their defense capacity to defend their sovereignty. The Indonesian government has carried out defense cooperation activities through defense diplomacy with 10 countries, the main partners, namely the United States, Australia, Malaysia, Russia, China, France, Singapore, the Netherlands, India, and Korea. Overall, this cooperation aims to strengthen deterrence capabilities and achieve stability and peace in the region. Defense cooperation in the form of joint exercises, exchange of intelligence data, patrols around border areas and arms trade has been carried out routinely by Indonesia.

One way that the government and people of Indonesia can support the development of a strong defense is to strengthen the independence of the defense industry in Indonesia. The defense industry can be in the form of State-Owned Enterprises (BUMN) and Private-Owned Enterprises (BUMS). In this context, the defense industry plays a role in providing advanced defense technology and can encourage Indonesia's defense independence.

There are several State-Owned Enterprises (BUMN) and Private-Owned Enterprises (BUMS) in Indonesia that have produced and developed UAVs. Here are some companies in the defense industry that have developed UAVs: (Syahlavida, Ali, Saragih, & Deksino, 2002)

1. PT Dirgantara Indonesia (PTDI) is an Indonesian aerospace company engaged in the design, development, and production of civil aircraft and military aircraft. One of the drones developed by PTDI is the Medium Altitude Long Endurance (MALE) Black Eagle which is capable of flying non-stop for more than 24 hours.
2. PT Bhinneka Dwi Persada is a company with experience in manufacturing UAV. The company supplies complete design, manufacture, and quality inspection. These products are Rajawali 330 and Rajawali 720.
3. PT Carita Boat Indonesia, a company designated as a defense industry by the Directorate General of Pothan Kemhan in 2016 is a company that produces ships and aircraft.
4. PT Len Industri (Persero) is a company that produces UAV mission systems to provide Guidance, Navigation, and Control (GNC) systems so that they can be implemented on all UAV platforms. Currently, the mission system is installed in the Wulung UAV.
5. PT Indo-Pacific Communication & Defense (PT. IPCD) is a privately-owned national company engaged in the design, manufacture, and marketing of UAV. Currently, PT IPCD is also collaborating with foreign partners in developing an UAV grade MALE (Medium Long Endurance) to meet the needs of the domestic and ASEAN markets.
6. Bhimasena Research & Technology, is a research, technology, and manufacturing agency that focuses on the defense industry with one of its activities being UAV manufacturing. The products are UAV type MAN PACK THROW SERIES SWG RI1 SYSTEM and UAV type VTOL SERIES BHIMASENA VTOL UAV.
7. PT Mandiri Mitra Muhibbah (M-3) is a company that provides specialized services, including repair and maintenance of weapons and communication systems for the Indonesian National Army. M-3 has been one of the leading drone and unmanned aircraft manufacturers since 2005 and has been supplying target drones to the Indonesian military. The M3 has in the industry manufacturing UAV Surveillance, target drones, and all spare parts, as well as maintenance and repair of radar and weapon systems.
8. PT UAVINDO Nusantara is a company engaged in technical activities based on aerospace technology and automation technology. The products from PT UAVINDO are the MR 40 and the Close Range C21SR Mission.

9. PT Famindo Innovation Technology, UAV service for agriculture, anti-drone technology, and UAV with vertical take-off and landing (VTOL) capabilities are produced. Made in a factory using 80% of national raw materials.

The use and function of UAVs have a significant impact on the development of a strong national defense with the independence of the defense industry. In terms of defense, this advanced industry plays a role in providing defense technology and can encourage Indonesia's independence in the future. Advanced defense technology needs to be produced from the domestic defense industry. Indirectly, the hidden greatness of the technology is not easily read by foreigners. This is to support the fulfillment of the need for independent and strong Defense and Security Equipment (Alpalhankam) in the future.

At the end of 2019, the Unmanned Aerial Vehicle Complex (PTTA MALE) launched the "Medium Altitude Endurance (MALE)" aircraft prototype. The Unmanned Aircraft of the Medium Altitude Long Endurance or Puna Male type, which is named the Black Eagle or Black Eagle, will be able to fly for 30 hours. The drone can fly at speeds of up to 235km per hour at an altitude of 10,000-30,000 feet. The drone, which weighs 1,300 kilograms and reaches 8.65 meters in length, and with a wingspan of 16 meters and a height of 2.6 meters is designed to be able to carry weights of up to 300 kilograms.

Figure 4. *UAV Black Eagle type MALE*

PUNA MALE was created to help protect NKRI ownership from the air very effectively and reduce casualties. The need for effective surveillance continues to grow in the face of threats from border areas, smuggling, piracy, and theft of natural resources such as fraudulent logging and fishing. The use of this drone is carried out to support intelligence, surveillance, reconnaissance, and targeting activities (intelligence, surveillance, reconnaissance, and targeting). PUNA Elang Hitam has 3 (three) supporting activities, namely the construction of platforms (rides), the construction of the flight control system (FCS) and mission system, as well as the development of weapons systems and their integration.

The PUNA MALE consortium was established in 2017, consisting of the Directorate General of Defense Potential of the Indonesian Ministry of Defense (Dirjen Pothan), the Indonesian Ministry of Defense Research and Development Agency (Litbang Kemhan), the Agency for the Assessment and Application of Technology (BPPT), the Faculty of Mechanical and Aerospace Engineering, the Bandung Institute of Technology (FTMD ITB), National Institute of Aeronautics and Space (LAPAN), PT. LEN Industry, PT Dirgantara

Indonesia, and the Indonesian Air Force Research and Development Service (Dislitbangau TNI AU). Meanwhile, several Defense Industries who have experience in UAV development such as PT Sari Bahari and PT Bhineka as well as Small and Medium Enterprises that have the potential for UAV development have not been involved in the project.

The Ministry of Defense acts as a supervisory and development program for the defense industry. TNI AU Dislitbang conducts a supervision program to always comply with Operation Requirements (OPSREQ). BPPT acts as the coordinator of the MALE Kombatan program within the framework of the National Research Priority (PRN), the technical coordinator of the National Strategic Project (PSN), carries out engineering and development activities, including the structure design process, calculation of the finite element method, making 3D drawings, and detailed 2D drawings. LAPAN has built a test mission test system, developed a SAR Radar payload, and a Communications Satellite-based Communication System (SatCOM). PT DI as the lead integrator plays a role in all technical (engineering) and manufacturing activities. PT LEN is the developer of the flight control system (FCS), sensors, radar, and weapons, while the procurement of the Flight Control System (FCS) itself is currently being produced in Spain. ITB acts as an institution that produces educated personnel to support this program.

Efforts to realize the independence of the defense industry cannot be separated from the concept of the three pillars of defense industry players and the concept of the defense industry cluster. The concept of the three pillars of the defense industry company refers to the integrated relationship between universities, the research and development (R&D) community as defense science and technology developers, and industry/private sector as users of defense science and technology, production, and distribution, and the TNI as the user of utilization. Meanwhile, the concept of the Defense Industry Cluster means that there is a mutually supportive relationship between the upstream and downstream industries to generate competitiveness and improve the national industry.

A strong industrial system is an industrial system that is built from upstream to downstream. This means that the supply of raw materials and components has been controlled by the domestic industry, so that dependence on imported materials can be minimized. Each of these industrial subsystems requires production levels that exceed their respective economies of scale to develop and exist in a sustainable manner (Montratama, 2018).

In terms of regulation, the realization of the independence of the defense industry is also supported by the Law of the Republic of Indonesia Number 16 of 2012 concerning the Defense Industry (Idhan) which requires the use of the main weapon system equipment (Alutsista) which is produced domestically. In the field of defense law, it is driven by efforts to transfer technology, namely grants in the form of compensation and compromises for defense equipment products, some of which are imported from abroad due to the inability of the defense industry to produce them. In addition to the Defense Law, the achievement of the independence of the defense industry is also regulated in Government Regulation of the Republic of Indonesia Number 74 of 2014 concerning the Trade Compensation Mechanism in the procurement of defense and security from abroad.

One of the derivative products of Law Number 16 of 2012 concerning the Defense Industry is Minister of Defense Regulation Number 8 of 2021 concerning the Implementation of Research and Development for Alpalhan Kemhan and the TNI which among other things states that the Ministry of Defense's Balitbang and Forces Research and Development (TNI AD, TNI AL, and TNI AU)) has the authority to carry out development from a prototype to a First Article which was previously only the authority of the Directorate General of Pothan Kemhan. In addition, according to the Presidential Regulation of the Republic of Indonesia Number 78 of 2021 concerning the National Research and Innovation Agency (BRIN), it is

stated that BRIN is no longer in charge of the development of Alpalhankam. This opens up opportunities for the Ministry of Defense Balitbang to expand its network and enhance its role as coordinator and integrator of research and technology development programs at the Ministry of Defense and the TNI by optimizing the role of the Defense Industry.

The success of efforts to achieve the independence of the defense industry is highly dependent on the synergy of the 3 pillars of the defense industry and the implementation of these concepts. The cluster concept above in the industrial sector supports each other. To see how well the two concepts work, several studies need to be conducted regarding the problems and challenges ahead to achieve independence from the defense industry. The role of national academics must also be optimized by providing academic contributions, both to the government and the Defense Industry. Academics should be allowed to be able to actively participate in building a better national defense system, especially for the development of the defense industry, including the procurement project for UAV alutsita in the defense industry.

The Agency for the Assessment and Application of Technology (BPPT) plays an important role in coordinating the defense industry (Idhan) to Small and Medium Enterprises that have the potential to develop UAVs to create an independent and universal defense industry.

3.4 The Need for Defense and Security in the Future

One of the efforts to increase national defense and security requires an independent defense industry to meet the needs of the National Alutsista. The definition of a defender in a broad sense is a person who assists justice seekers in the process of resolving cases in court (Octarina, 2021). The defense industry is one of the national interests to improve the economy, foreign exchange, and national welfare, as well as protect national interests abroad. Indonesia is predicted to become a large new economy in the world by 2030, so it has the potential to have a strong defense industry without relying on defense equipment from abroad. To prove this prediction, the defense industry must be prepared as soon as possible to build the independence of the National Alutsista. In-Law Number 16 of 2012 concerning the defense industry, the defense industry is classified as a strategic industry that is protected by the state and is expected to meet the demand for defense equipment and reduce dependence on defense equipment from other countries.

The use of the UAV system can make a suitable substitute for dealing with various existing problems, as well as responding to the impact of rapid and consistent technological advances in line with the implementation of Revolution in Military Affairs (RMA). The ability of the UAV system in air surveillance in the national area with uniqueness and advantages, including from the aspect of altitude, flexibility, and range, performance risks can be minimized, and the ability to fly for a relatively long time is taken into consideration. This is important because UAVs can be used as a reliable weapon system that can be used to support national defense. The development of a UAV system that emphasizes technology, integration, and interoperability is very important, so it must be an effective and efficient solution to be implemented in the future to support the supervision of the territorial integrity of the Unitary State of the Republic of Indonesia and the security of the entire country from all forms of threats (Pasaribu, Bonar, & Anwar, 2017).

The procurement of UAVs is one of the programs that will be realized by President Jokowi as a tool to maintain the defense, security, and territorial sovereignty of the Republic of Indonesia. This was conveyed by him during the presidential debate in 2019. Furthermore, according to the Strategic Plan of the Ministry of Industry 2015-2019 on the High Technology-Based Leading Industry Development Program, one of the stages is carried out through the Aerospace-Based Industry Growth activity. Technology development and drone production are very appropriate in terms of strategic planning.

Unmanned mapping technology is a choice in addition to other mapping technologies such as aerial photography, both large and small manned and satellite-based mapping. This technology is very promising to be applied and developed according to the topographical and geographical characteristics of Indonesia (Wikantika, 2008)

IV. Conclusion

UAV technology can be used for environmental and security monitoring, weather monitoring, meteorological research, agriculture, mineral exploration, and mining even for military purposes. In the military world, UAVs take over aerial surveys for both war and security and control matters. There are two types of unmanned aircraft, namely multicopter and fixed-wing. Fixed-wing has a shape like a conventional airplane equipped with wings. While the multicopter does not use wings, it only uses the rotation of the propeller to fly. Currently, Indonesia has several UAV development industries to support the development of a strong national defense although several factors are still constrained, one of which is that UAV experts are not well coordinated and are still innovating with their respective perspectives. To optimize the development of AUV to support the future needs of the Defense and Defense Agency, the Agency for the Assessment and Application of Technology (BPPT) plays an important role in coordinating the defense industry (Idhan) to Small and Medium Enterprises that have the potential to develop UAVs to create an independent and universal defense industry.

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