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The Strategic Role of the C-130 Hercules Aircraft as A Component of Indonesia's Air Defense in Facing National Security Threats

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ABSTRACT
Indonesia's air defense faces increasing complexity from military and non-military threats, such as smuggling, transnational terrorism, and airspace violations, driven by its strategic geographic location. This research aims to analyze the operational readiness of the C-130 Hercules aircraft and its strategic role in Indonesia's air defense. Drawing on a theoretical framework encompassing Defense Theory, Air Power Theory, and Triple Helix Theory, this qualitative study employs literature reviews and in-depth interviews with sources from the National Air Defense Operations Command and Depohar 10. The results indicate that the C-130 Hercules plays a crucial role in Indonesia's air defense, although its operational readiness remains suboptimal due to technical, logistical, and managerial challenges. Factors such as aging aircraft, structural fatigue, and delays in importing spare parts contribute to these readiness issues. However, the Triple Helix ecosystem— involving the government (policy and procurement), industry (PT Dirgantara Indonesia for maintenance and spare parts), and academia (research on modern maintenance and human resource development)—plays a key role in strengthening its strategic capacity. The Indonesian Air Force's tiered maintenance system, revitalization, and modernization programs reflect ongoing efforts to sustain the Hercules as a vital strategic asset for Indonesia's defense mobility.

INTRODUCTION

National security is a condition that reflects a country's ability to protect its sovereignty, territorial integrity, and safety from various threats. In the Indonesian context, national security threats can be military or non-military (Katzenstein, 2018; Matondang, 2019; Montasari, 2022; Patel & Chudasama, 2021). Military threats include potential aggression, airspace violations, armed conflict, and geopolitical tensions in the Indo-Pacific region. Meanwhile, non-military threats include terrorism, natural disasters, social conflicts, and cyberattacks. According to Buzan (1991: 432), the concept of national security is no longer limited to military threats alone but also includes political, economic, social, and environmental dimensions. This confirms that the threats to Indonesia as a large archipelago nation are very complex and multidimensional. Indonesia's strategic geographical location along international trade routes—including the Strait of Malacca and the Natuna Sea—makes its airspace vulnerable to illegal activities such as smuggling, transnational terrorism, and boundary violations (Mahmood et al., 2022; Vysotska et al., 2025; Yerden et al., 2025). Therefore, the readiness of the air defense system is a main prerequisite for maintaining national stability and security.

Indonesia's air defense system is designed to secure national airspace, which spans 5.9 million km², including the Exclusive Economic Zone (EEZ) (Ministry of Defense of the Republic of Indonesia, 2021: 56). The Indonesian Air Force (TNI AU), as the main component, is responsible for maintaining national airspace in accordance with Law Number 34 of 2004 concerning the Indonesian National Armed Forces (TNI) (Pratama et al., 2024; Ubayanto et al., 2020; Yasir et al., 2021). The Swa Bhuwana Paksa doctrine emphasizes that air superiority is a determining factor for the success of defense operations (TNI AU, 2018: 12). Indonesia's air defense components consist of fighter aircraft, transport aircraft, radar, missile defense systems, and ground-based air defense units. Among these, transport aircraft play a strategic role as the backbone for mobilizing logistics, troops, and humanitarian assistance during crises. According to Arifianto (2022: 49), the effectiveness of a country's air defense is not determined solely by combat power but also by the readiness of fast, integrated, and sustainable logistics support. Thus, transport aircraft are a vital element in building an Indonesian air defense that is resilient and adaptive to dynamic threats.

The C-130 Hercules transport aircraft has been a strategic asset in Indonesia's air defense system since the 1960s, with more than 20 units distributed across several air squadrons by 2023. Known for its ability to transport logistics, troops, and combat vehicles and to operate on short runways, the C-130 Hercules also plays an important role in humanitarian missions, such as disaster relief and the evacuation of Indonesian citizens from Afghanistan (Suryaningrum, 2022). With escalating threats, procuring the C-130J Super Hercules is urgent to enhance avionics capabilities and operational efficiency (Boeing Report, 2022). The C-130 also supports the mobility of Indonesia's air power—including troop deployment and logistics distribution—and serves as an important component of a layered air defense system, leveraging its short takeoff and landing (STOL) capabilities to adapt to Indonesia's complex geography (Douhet, 1921).

However, despite its strategic role, the C-130 Hercules faces challenges in maintenance and operational readiness. Parts of the fleet consist of aging aircraft with high flight hours, which require intensive maintenance and suffer from delays in spare parts. In addition, operational readiness levels often fall below international standards (Global Air Power Review, 2021). Moreover, a gap exists between modernization needs and the capacity of the domestic defense industry, particularly in digital technology-based maintenance and independent component production (Supriyatno, 2014). Therefore, this research aims to optimize the strategic role of the C-130 Hercules aircraft as a component of Indonesia's air defense in facing national security threats through modernization and collaboration among government, industry, and academia to ensure the aircraft's sustained role against such threats.

The urgency of this research stems from Indonesia's need for a resilient, adaptive, and competitive air defense system in the region. The evolving geopolitical landscape in Southeast Asia—including intensifying U.S.-China rivalry and potential conflict in the South China Sea—demands high readiness of defense equipment (Laksmana, 2020). The C-130 Hercules, with its strategic transport functions, is key to supporting logistical mobility, troop deployment, and joint operations. Meanwhile, the national defense modernization under the Minimum Essential Force (MEF) requires transforming defense equipment management, including digital maintenance and defense industry independence (Ministry of Defense of the Republic of

Indonesia, 2021: 88). This research is urgent because it contributes to formulating strategic policies to maintain the C-130's role.

Thus, this research stems from awareness of the C-130 Hercules aircraft's importance as a strategic component of Indonesia's air defense, offering vital contributions to state sovereignty. Despite challenges in maintenance, modernization, and integration within the defense ecosystem, this aircraft remains the backbone of the Air Force's air mobility. Through in-depth analysis of its strategic roles, current problems, and future development strategies, this research aims to provide practical solutions and policy recommendations for strengthening the national defense industry and enhancing Indonesia's air defense readiness against national security threats.

Based on the background described above, this study addresses two main research questions: first, how the operational readiness of the C-130 Hercules aircraft supports the Indonesian air defense system; and second, how to implement the strategic role of the C-130 Hercules aircraft as a component of Indonesia's air defense in facing national security threats.

The purpose of this study is to analyze the operational readiness of the C-130 Hercules aircraft in supporting Indonesia's air defense system and to examine its strategic role as an air defense component against national security threats. The benefits of this research fall into two categories: academic and practical. Academically, it contributes to air defense studies, particularly on the strategic role of the C-130 Hercules transport aircraft in facing national security threats. It also enriches literature on Triple Helix theory in defense contexts by highlighting collaboration among government, industry, and academia to strengthen national defense. Furthermore, it serves as a reference for future research on air defense modernization, digital maintenance of defense equipment, and strategies for Indonesian defense industry independence.

Practically, this research provides strategic input for the Indonesian Air Force to improve C-130 Hercules operational readiness through optimized maintenance, modernization, and logistical support. It also offers considerations for the Ministry of Defense and national defense industry in formulating Triple Helix-based modernization policies. Finally, it delivers practical recommendations for defense stakeholders to enhance synergies among government, industry, and academia, fostering national defense industry independence and competitiveness.

METHOD

This research examined *the strategic role of C-130 Hercules aircraft as a component of Indonesian air defense in facing national security threats* using a qualitative approach. Qualitative research in political science was a systematic method for understanding political phenomena through in-depth exploration of the experiences, perceptions, and interpretations of political actors in specific social and cultural contexts. This approach emphasized the importance of understanding the "why" and "how" of political behavior, not just the "what" that occurred.

According to Yanow and Schwartz-Shea (2014), qualitative research in political science was an investigative method that sought to understand the meanings individuals and groups constructed around their political reality, using data collection techniques that captured the nuances and complexities of political life.

In this study, data collection employed qualitative techniques, primarily literature studies involving reputable journals, documents, and legislation. According to Hart (2018), a literature review in political science was defined as a systematic process to identify, evaluate, and synthesize relevant research and scholarship, thereby building a theoretical foundation and identifying research gaps.

In addition to data from literature studies, this researcher conducted interviews. Interviews in political science research were defined as intensive data collection techniques using open-ended questions to explore respondents' understandings of phenomena in substantial detail, typically lasting 1–2 hours with a focus on information quality rather than quantity (Seidman, 2013). The list of interviewed respondents was as follows:

1. Major General *TNI* Trias Wijanarko, S.I.P., M.H.I., Head of the National Air Defense Operations Command.
2. First Marshal of the Indonesian Armed Forces Dr. Agus Priyanto, psc., S.E., M.M., M.Sc., Planning Assistant of the National Air Operations Command.
3. Lt. Col. Tek Chrisna Cakti Samiaji, M.Pd., Commander of *Sathar* 15 *Depohar* 10.

For data analysis, this study used a qualitative approach. Qualitative data analysis was a systematic process for organizing, interpreting, and understanding non-numerical data from qualitative research. Creswell & Creswell (2017) explained that qualitative data analysis was an ongoing process involving reflection on the data, analytical questions, and memo-writing throughout the research. This process differed from quantitative analysis because it was inductive, interpretive, and holistic.

Bogdan and Biklen (2017) emphasized that qualitative data analysis was not only about organizing data but also about identifying patterns, themes, and meanings that emerged from it. Qualitative researchers worked with rich contextual data—such as interview transcripts, observation notes, documents, photographs, or other artifacts—that could not be quantified numerically.

RESULTS

Operational Readiness of C-130 Hercules Aircraft in Support of Indonesia's Air Defense System

Figure 1. Interview with Marsma TNI Dr. Agus Priyanto, psc., S.E., M.M., M.Sc
Source: Researcher's documentation, 2025

Based on an interview with the First Marshal of the Indonesian Armed Forces Dr. Agus Priyanto, psc., S.E., M.M., M.Sc., Planning Assistant of the National Air Operations Command (November 2025 Interview), the operational readiness level of the C-130 Hercules aircraft is greatly influenced by the condition of the aircraft population and the maintenance cycle carried out by the Indonesian Air Force. Currently, the number of Hercules aircraft readiness in Squadrons 31, 32, and 33 is recorded at 6 aircraft, 6 aircraft, and 4 aircraft, respectively, which shows that readiness depends not only on the availability of aircraft but also on the effectiveness of maintenance and logistics. Aircraft maintenance is carried out in three levels, namely light at the squadron level, medium by the Engineering Squadron, and heavy by Depohar 10, which includes the manufacturer's standards and the SMP-515 Inspection Program. However, the biggest challenges are the age of the aircraft, structural fatigue, and dependence on imported parts that have a waiting time of 1–2 years. Hangar capacity and domestic MRO capabilities are also still limited, and technical human resource challenges related to mastering new avionics technology in the C-130J type are still limited in the Indonesian Air Force.

In addition, Marsma TNI Dr. Agus Priyanto also emphasized that logistics readiness still depends on imports, which hinders the independence of the domestic industry. Although certified technician training cooperates with international manufacturers, training opportunities are still limited. The C-130 Hercules has a strategic role in air defense, with STOL capabilities, large carry-on capability, and operational flexibility that allow for troop mobilization, logistics distribution, and radar distribution to remote bases. Operational readiness is maintained through integrated coordination between the National Headquarters, Air Squadron, and Depohar, as well as an operation planning mechanism that is synchronized with maintenance. Hercules remains the backbone of the Air Force's strategic mobility and plays an important role in supporting rapid responses to military and humanitarian threats.

Figure 2. Interview with Lt. Col. Chrisna Cakti Samiaji, M.Pd.
Source: Researcher’s documentation, 2025

Based on an interview with Lt. Col. Chrisna Cakti Samiaji, M.Pd., Commander of Sathar 15 Depohar 10 (November 2025 Interview), the operational readiness of the C-130 Hercules aircraft is highly dependent on the effectiveness of maintenance carried out by the Indonesian Air Force, especially at Depohar 10. Although these aircraft undergo multi-level maintenance, including daily inspections, moderate maintenance every 3,000 flight hours, and heavy maintenance every 6,000 flight hours, several challenges arise, such as the aging of the aircraft, structural fatigue, delays in the supply of imported parts, as well as limited hangar facilities and

domestic MRO capacity. Logistics readiness that depends on the import of spare parts and the limitation of technician training are the main issues. Nonetheless, Lt. Col. Chrisna emphasized that the C-130 Hercules remains a vital strategic asset with STOL capabilities, large carry capacity, and operational flexibility, supporting troop deployment, logistics distribution, and air defense operations. Close coordination between Koopsudnas, squadrons, and Depohar ensured that Hercules' operational readiness was maintained, despite the challenges it faced.

Figure 3. Interview with Major General TNI Trias Wijanarko, S.I.P., M.H.I.
Source: Researcher's documentation, 2025

Based on the results of an interview with Major General TNI Trias Wijanarko, S.I.P., M.H.I., the position of Treasury of the National Air Defense Operations Command (November 2025 Interview), it was obtained that the operational readiness of the C-130 Hercules aircraft cannot be separated from the condition of the fleet population spread across the three main squadrons of the Indonesian Air Force. He explained that official data from the Indonesian Air Force shows variations in the type, number, and level of readiness of aircraft that have direct implications for the ability of national strategic mobility. According to him, understanding the population structure is the first step to more accurately assess maintenance workloads and industry support needs.

Table 1. Population of C-130 Hercules Aircraft by Squadron

Air Squadron	Aircraft Type	Quantity	Ready for Operation
31st Air Squadron	C-130 HS / L-100	8	
	C-130J	5	**6 total ready**
32nd Air Squadron	C-130B	2	
	C-130H	3	
	C-130 L-100	2	
	C-130 KC	1	**6 total ready**
33rd Air Squadron	**C-130H**	**8**	**4 Ready**

Source: TNI AU internal data, processed from interview with Major General TNI Trias Wijanarko, S.I.P., M.H.I., 2025.

Maj. Gen. Trias Wijanarko, S.I.P., M.H.I., emphasized that although the Indonesian Air Force has a sizable C-130 fleet, the number of diverse aircraft variants, such as the C-130B, KC-130B, H, HS, L-100, and C-130J, adds to the complexity of maintenance. Differences in

avionics, engines, and structural components configurations affect the maintenance efficiency and readiness of the aircraft. Of the total fleet in the 31st, 32nd, and 33rd Squadrons, only a portion is operationally ready, due to long maintenance cycles, delays in the procurement of imported parts, and variations in aircraft wear and tear. Operational readiness is also influenced by the capacity of the national industry to provide spare parts and overhaul capabilities, with PT Dirgantara Indonesia facing challenges in meeting these needs. In addition, the aircraft's more than four decades of age adds to the difficulties in structural maintenance and increases the duration of maintenance. Nonetheless, new technologies such as the C-130J present new challenges in terms of technician competencies that must be improved. The collaboration between the Indonesian Air Force, Depohar 10, and PT Dirgantara Indonesia is the key to improving the readiness of the C-130 aircraft. Hercules remains a key strategic asset in supporting the mobility of the Indonesian air force, both for defense and humanitarian operations.

a. Defense Equipment Transportation

In the context of air and ground defense, the C-130 Hercules plays an important role as a strategic transport aircraft to mobilize defense equipment to the area of operation. The large carrying capacity of more than 20 tons allows the Hercules to transport a wide range of military equipment, including tactical vehicles, light weapons systems, as well as radar components. This role is very vital given Indonesia's geographical challenges as an archipelagic country that requires fast air connectivity to move defense equipment from one base to another.

One concrete example is the deployment of Weibel and Skyshield Radar to border areas in the 2019–2021 period in order to strengthen early detection and national air defense systems. According to a report by the Indonesian Air Force (2021), the delivery of radar devices that have a large weight can only be carried out using the C-130 Hercules because land and sea access in border areas is very limited (TNI AU, 2021: 52). In another case, Hercules was also used to transport Komodo and Anoa tactical vehicles to support TNI operations in Natuna when there was an increase in foreign vessel activity in the South China Sea in early 2020. National media reported that the deployment of the defense equipment was carried out in a short time through the Hercules airbridge as a form of response to regional security dynamics (Kompas, 2020).

In addition, Hercules is also used to transport military communication system modules and ground support equipment in joint TNI exercises every year. Without Hercules, the process of moving defense equipment to training areas such as Papua, Natuna, or Kalimantan would take much longer and potentially hamper operational readiness. This is in line with the concept of air mobility power which emphasizes that air power is not only determined by fighter aircraft, but also by the ability to transport which supports rapid force projection (Douhet, 1921).

b. Personnel Transportation

In addition to transporting defense equipment, the C-130 Hercules has a strategic function in personnel transportation, both for military and humanitarian operations. The carrying capacity of up to 92 troops (in a troop transport configuration) or 64 paratroopers makes it the main platform for the Indonesian Air Force to quickly deploy troops to locations in need. The use of Hercules in personnel transport has been proven in various military and non-military operations.

The most prominent example is the deployment of TNI personnel to Palmyra, Central Sulawesi, during emergency response operations after the 2018 Palu earthquake and tsunami. The BNPB report (2019) stated that the C-130 Hercules became the backbone of the mobilization of thousands of TNI troops and volunteers from various regions such as Jakarta, Makassar, and Malang to Palu, when many airports could not be landed by civilian aircraft due to runway damage (BNPB, 2019: 112). Hercules aircraft also played a role in evacuating the wounded, including patients who needed intensive care to hospitals in safe areas such as Balikpapan and Makassar.

In military operations, Hercules has been used several times to transport Quick Reaction Force (QRF) troops to conflict-prone areas, such as Papua and Maluku. According to an internal report by Koopsudnas (2020), Hercules was able to transport a full platoon and their personal equipment in a single sortie, thus significantly shortening the response time of operations. This reflects the principle of rapid deployment capability, which is a fundamental element in modern defense strategies.

The use of Hercules in personnel transportation is also seen in joint TNI exercises and international exercises such as Garuda Shield. In this activity, Hercules was tasked with moving personnel between bases and supporting airborne operations. This role underscores that personnel cannot be effectively mobilized without the support of strategic transport forces, and the Hercules is a component that enables such flexibility.

c. Transportation Logistics

The C-130 Hercules is the main aircraft of the Indonesian Air Force in large-scale logistics transportation operations. Its ability to transport a wide range of cargoes, from foodstuffs, medicines, fuel, to emergency supplies, makes it essential for both defense and humanitarian operations. In the context of air defense, air logistics capabilities ensure that defense equipment, troops, and air bases can survive and operate sustainably, especially when land and sea access is disrupted.

One of the real examples of the use of Hercules in logistics transportation is during the 2010 eruption of Mount Merapi and the massive flood in Sentani in 2019. National media reported that Hercules transported more than 250 tons of logistics to disaster-affected areas in the first few days, when the land distribution lines could not function optimally (Tempo, 2019). In the case of the 2018 Palu Earthquake, Hercules was the only aircraft that could land at the badly damaged Mutiara Sis Al-Jufri airport. The BNPB report (2019) shows that more than 400 tons of logistics were successfully transported using Hercules in the first week after the disaster (BNPB, 2019: 118).

In the defense sector, Hercules supports the distribution of key logistics to border air bases such as Natuna, Biak, and Morotai. The logistics include aviation fuel, radar components, ammunition, and maintenance equipment. This becomes crucial when the geopolitical situation heats up in the South China Sea and the TNI increases air operations preparedness. It is in this context that Hercules becomes the main enabler that ensures the sustainability of operations at bases far from logistics centers.

The role of Hercules' logistics is also seen in international aid deliveries. For example, in an aid mission to the Philippines after Typhoon Haiyan in 2013, the Indonesian Air Force sent humanitarian logistics using C-130 Hercules as part of Indonesia's defense diplomacy (Indonesian Ministry of Foreign Affairs, 2014).

d. Ability to Face National Threats

The role of the C-130 Hercules in dealing with national threats is not only logistical and transportation, but also directly related to the country's ability to respond to various military, nonmilitary, and hybrid threats. In the concept of national security, the ability to project strength and respond quickly is the main indicator of the country's readiness to face threats. Hercules fulfills this function because it is able to reach all regions of Indonesia with high flexibility. In the context of military threats, the Hercules supports air defense operations by transporting portable radars, missile components, as well as maintenance teams to strengthen frontline air bases. The strengthening of radar in Natuna in 2020 when there was an increase in foreign military activity is an example of Hercules' strategic role in maintaining territorial sovereignty (TNI AU, 2020). The aircraft is also used in combat support operations, such as logistics replenishment to bases used for aerial monitoring operations.

In the face of non-military threats, Hercules is a vital tool to respond to natural disasters that can weaken national stability. The cases of Palu 2018, Yogyakarta 2006, and Lombok 2018 show that without Hercules, aid delivery and evacuation of victims cannot be done quickly, so social and security threats can worsen. Regarding hybrid threats, Hercules plays a role in maintaining societal resilience through supporting humanitarian operations, evacuating Indonesian citizens from conflict areas such as the evacuation of Indonesian citizens from Afghanistan in 2021 using the C-130 (Indonesian Ministry of Foreign Affairs, 2021)—as well as the delivery of critical equipment during the COVID-19 pandemic.

Thus, Hercules is not only a transport aircraft, but a pillar of national defense that allows Indonesia to maintain stability, respond to threats, and strengthen deterrence in peaceful and crisis situations.

Hercules' Strategic Role Through the Triple Helix in Facing National Threats

Based on the results of an interview with the First Marshal of the Indonesian Air Force, Dr. Agus Priyanto, psc., S.E., M.M., M.Sc., the position of Planning Assistant of the National Air Operations Command (November 2025 Interview) stated that the strategic role of the C-130 Hercules aircraft in the context of Indonesian air defense is increasingly evident when viewed through the lens of Triple Helix collaboration, namely the synergy between the government (TNI AU/Ministry of Defense), industry (PT Dirgantara Indonesia), and academics. According to Marsma TNI Dr. Agus Priyanto, psc., S.E., M.M., M.Sc., the government has set a strategic direction for the use of Hercules as a national air mobility enabler for both War Military Operations (OMP) and Non-War Military Operations (OMSP) with procurement policies (C-130J-30), life-extension programs for old fleets, as well as budget priorities for modernization and MRO directed at increasing national readiness. The policy is not just an allocation of funds, but also includes the determination of an industry-government cooperation scheme to shorten the supply chain of spare parts and ensure operational airworthiness.

From an operational perspective, Marsma TNI Dr. Agus Priyanto, psc., S.E., M.M., M.Sc. emphasized that the sustainability of the role of Hercules depends on the capacity of Depohar 10 and national industrial facilities to carry out heavy maintenance and avionics upgrades. He explained that structural programs such as the Center Wing Box Replacement (CWBR) and the Avionics Upgrade Program (AUP) coordinated between the Ministry of Defense, the Indonesian Air Force, and PT DI are concrete examples of how the Triple Helix elements

interact: the government provides mandates and funding, PT DI acts as a technical integrator and implementer of MRO, while academics have the potential to provide technical studies, innovative inspection methods, and predictive maintenance research that can reduce the frequency of failure. The implementation of CWBR, according to him, has a direct impact on extending the service life of the airframe and increasing safety margins, so that the long-term readiness of the fleet increases.

Marsma TNI Dr. Agus Priyanto, psc., S.E., M.M., M.Sc. also underlined the role of the industry not only as an implementer of improvements, but also as a local capacity developer for critical components. He stated that PT DI has started to take a bigger role in certain local component repairs and fabrications, but this capacity still needs to be increased so that Indonesia does not always depend on foreign vendors who have a lead time of 12-24 months for certain components. From the perspective of the Indonesian Air Force, the development of PT DI's capabilities is strategic because every shortening of the supply time directly improves the maintenance turnaround time and increases the number of aircraft ready for operation.

Regarding the role of academics, Marsma TNI Dr. Agus Priyanto, psc., S.E., M.M., M.Sc. assessed that the involvement of universities and research institutions is the key to accelerating the digitalization of maintenance—for example through the development of health monitoring systems, predictive maintenance algorithms, and big-data analysis for damage patterns. Research-industry collaboration could result in new non-destructive inspection methods or more accurate component life prediction models, which are then integrated into Depohar 10's maintenance schedule. He emphasized that the combination of academic knowledge and industry capabilities produces practical solutions that strengthen readiness holistically.

At the end of his statement, Marsma TNI Dr. Agus Priyanto, psc., S.E., M.M., M.Sc. acknowledged a number of bureaucratic obstacles between agencies, differences in technical standards, and limitations in research funding that must be overcome in order for the Triple Helix model to function optimally. However, he is optimistic that with clear project governance (e.g. PKS between the Ministry of Defense-TNI AU-PT DI), capacity building of PT DI, and directed research programs from academics, the strategic role of Hercules as an air defense enabler can be maintained and improved to face the dynamics of national threats.

Based on the results of an interview with Lt. Col. Chrisna Cakti Samiaji, M.Pd., as the Commander of Sathar 15 Depohar 10 (Interview November 2025), it was explained that the strategic role of the C-130 Hercules in facing national threats can only be maintained if collaboration within the framework of the Triple Helix runs effectively and sustainably. According to him, the government through the Ministry of Defense and the Indonesian Air Force not only acts as a user of defense equipment, but as a policy direction that determines how the Hercules is empowered, maintained, and modernized. The designation of Hercules as a strategic air mobility asset makes this aircraft the main platform to respond to various forms of threats, ranging from force mobilization within the OMP to humanitarian operations within the OMSP. In his view, policies such as the C-130J modernization program, the revitalization of the old fleet, and the strengthening of Depohar 10 reflect the government's commitment to ensuring the Hercules remains at a high level of operational readiness in the long term.

Lt. Col. Chrisna explained that in terms of technical implementation, Depohar 10 is the main node in the process of industrialization of C-130 maintenance, and this is where the role of industry, especially PT Dirgantara Indonesia, gets a significant space. According to him, PT

DI's role is not limited to providing spare parts or performing component repairs, but also involved in structural engineering and aircraft service life extension programs. He cited the Center Wing Box Replacement program and avionics system upgrades as concrete examples of how the industry supports the Hercules capability enhancement. Without industry participation, the overhaul process will be completely dependent on external parties which will take longer and cost more, which can reduce operational readiness. The collaboration between Depohar 10 and PT DI in heavy maintenance work, according to him, is the main backbone of the sustainability of C-130 aircraft in Indonesia.

In the interview, Lt. Col. Chrisna also highlighted the role of academics as an increasingly important element in the era of digitalization of maintenance systems. He explained that university research on predictive maintenance, non-destructive inspection techniques, and the integration of digital monitoring systems provides a scientific basis for modernizing Hercules maintenance. According to him, the implementation of data-based technology is very relevant considering the varying age of fleets and increasing levels of structural fatigue. Academics also contribute through the preparation of technician training curriculum, material research, and component failure risk analysis. Thus, the existence of academics not only strengthens the scientific aspect, but also increases the capacity of human resources and the effectiveness of maintenance management.

Furthermore, he emphasized that the strategic role of the Hercules in dealing with national threats cannot be separated from the aircraft's ability to support cross-dimensional operations. Hercules, according to him, has repeatedly been the backbone in the mobilization of rapid reaction forces, the delivery of large defense equipment, and the distribution of logistics to crisis areas. He said that in various disaster situations, Hercules was the first aircraft to be able to land at the affected location because of its STOL capabilities and large carrying capacity. Strengthening this capability will not be achieved without the synergy of the government that sets strategic needs, industries that ensure technical readiness, and academics who present science-based maintenance innovations.

Closing his explanation, Lt. Col. Chrisna emphasized that the Triple Helix is not just a concept, but a practical approach that has been running in the life cycle of Hercules. Challenges such as budget limitations, procurement bureaucracy, and the ability of the industry to be fully independent still arise. However, he is confident that if coordination mechanisms are strengthened, research investment is increased, and industrial capacity is expanded, Hercules will remain a vital component of Indonesia's air defense in responding to future national security threats.

Based on the results of an interview with Major General TNI Trias Wijanarko, S.I.P., M.H.I., the position of Treasury of the National Air Defense Operations Command (November 2025 Interview) stated that the strategic role of the C-130 Hercules aircraft in facing national threats can only function optimally if the Triple Helix collaboration model is applied consistently and integrated. According to him, the three elements of government, industry, and academia have different but complementary contributions in maintaining the sustainability of the maintenance and modernization of Hercules as an air defense asset. From the government's side, he assessed that the Indonesian Air Force together with the Ministry of Defense have provided a clear policy direction by designating Hercules as the core platform of national air mobility. This policy can be seen through the revitalization program of the old fleet, the

procurement of C-130J aircraft, as well as budget priorities for overhaul, refurbishment, and structural improvements that are urgent needs given the variation in airframe age. The government also plays a role in determining international cooperation mechanisms that allow knowledge transfer and acceleration of the supply of critical parts that domestic industries cannot produce.

From an industrial perspective, Major General TNI Trias Wijanarko, S.I.P., M.H.I. explained that PT Dirgantara Indonesia has a big responsibility in supporting the sustainment of C-130 aircraft. He said that PT DI is not only involved in component repair or the provision of certain spare parts, but also becomes the main partner of Depohar 10 in heavy maintenance and structural engineering programs. Programs such as Center Wing Box Replacement (CWBR), structural reinforcement, and avionics modernization are tangible forms of the industry's contribution in keeping the Hercules compliant with safety and airworthiness standards. However, he also emphasized that the capabilities of the national industry still need to be strengthened, especially in the supply of imported materials which has been the main obstacle because the waiting time for procurement can reach 12-24 months. He assessed that increasing domestic manufacturing capacity will accelerate the readiness level of aircraft which has been greatly influenced by the length of the international logistics cycle.

Furthermore, he highlighted that Triple Helix also includes the involvement of academics as a catalyst for innovation. In his view, the contribution of universities and research institutions is needed to improve maintenance methods, including research related to materials, analysis of structural failures, and the development of digital systems to support data-based maintenance. He said that technologies such as digital logbooks, predictive maintenance algorithms, and non-destructive inspections based on artificial intelligence are the results of research that are starting to receive attention and are relevant to be applied to the Hercules fleet in the near future. According to him, synergy between academia and industry can produce a leap in efficiency while reducing the level of dependence on conventional maintenance methods.

Regarding the context of national threats, Major General TNI Trias Wijanarko, S.I.P., M.H.I. explained that Hercules plays three main roles: troop mobility, defense transportation/logistics, and emergency response. He emphasized that the success of this aircraft in carrying out this function cannot be separated from the technical readiness created through the cooperation of Triple Helix. He gave an example of how Hercules was used in the strengthening of the air base in Natuna, the delivery of critical logistics during the COVID-19 pandemic, as well as support for national disaster evacuation such as Palu 2018. All of these operations require high aircraft readiness, accurate maintenance capabilities, and strong policy coordination at the government level.

Closing his explanation, he emphasized that challenges such as procurement bureaucracy, industrial capabilities that are still gradually developing, and limited research capacity should not hinder the strengthening of the Triple Helix ecosystem. He believes that by improving governance, increasing investment in defense industry facilities, and strengthening cooperation between the Indonesian Air Force and PT DI-academics, Hercules can continue to play a strategic role as a component of Indonesia's air defense in facing increasingly complex national security threats.

Analysis of the operational readiness of the C-130 Hercules aircraft in supporting the Indonesian air defense system.

The analysis of the operational readiness of the C-130 Hercules aircraft is a key stage in understanding the Air Force's ability to carry out an effective air defense function and be responsive to the dynamics of national threats. Operational readiness does not only describe the technical condition of the aircraft, but reflects the entire supporting ecosystem, ranging from maintenance systems, availability of spare parts, technician competencies, MRO facilities, to government strategic policies and inter-unit coordination mechanisms. Therefore, this discussion seeks to integrate field findings with the framework of defense theory, defense management theory, and readiness theory to provide a comprehensive understanding of how the readiness of the C-130 Hercules contributes directly to the air defense posture

Indonesia. This analysis is important considering that the C-130 Hercules is the backbone of strategic air mobility that allows the Indonesian Air Force to project air power, deploy radars, transport troops, and strengthen air bases in priority areas, so that its operational readiness has direct implications for the country's resilience and Indonesia's deterrence capabilities.

The results of data processing from the three informants show that the operational readiness level of the C-130 Hercules aircraft is greatly influenced by the condition of the fleet population, the tiered maintenance cycle, the capacity of maintenance facilities, and the availability of spare parts. TNI AU data illustrates that the population composition of the Hercules is spread across three squadrons, namely Air Squadron 31 with 13 units (8 C-130HS/L-100 and 5 C-130J) with 6 units ready for operation; 32nd Air Squadron with 8 units (B, H, L-100 and KC variants) with 6 units ready; and Air Squadron 33 with 8 C-130H units with 4 units ready for operation. This variation in readiness is mainly due to differences in aircraft age, structural fatigue levels, intensity of use, and the number of aircraft undergoing heavy maintenance. The three informants explained that operational readiness is directly affected by the C-130's maintenance system which consists of light maintenance at the squadron level, intermediate maintenance every 3,000 flight hours or three years, and heavy maintenance at Depohar 10 every 6,000 flight hours or six years. These maintenance procedures follow the manufacturer's standards and the SMP-515 Inspection Program that governs specific inspections of critical components. However, its implementation faces various obstacles, especially the length of the procurement time for imported parts which can reach 12-24 months, the limitations of hangars and MRO equipment, and the need to improve the competence of technicians in the face of the modernization of C-130J avionics. The informant emphasized that the age of some airframes that have reached more than 40 years has also extended the duration of maintenance due to the need for in-depth inspections related to the structure and corrosion potential. In addition to technical factors, operational readiness is also affected by the capacity of the domestic industry, especially PT Dirgantara Indonesia—which is currently only able to handle some components and most component repairs, so that dependence on foreign vendors remains high. Thus, the results of data processing show that the operational readiness of the C-130 Hercules is a multidimensional issue involving technical, logistical, industrial, and policy aspects, which overall determines the ability of this aircraft to support Indonesia's air defense system optimally.

To clarify the overall findings regarding the operational readiness of the C-130 Hercules aircraft, the results of data processing are summarized in the following table. This table

summarizes the main aspects of readiness based on aircraft population conditions, maintenance capacity, technical challenges, logistical limitations, and industrial support that affect the ability of Hercules to support Indonesia's air defense system.

Interpretation of the data processing results shows that the operational readiness of the C-130 Hercules aircraft is the result of a complex interaction between technical, logistical, organizational, and national industrial capacity factors. Aircraft population data shows a gap between the number of assets owned and the number of aircraft that are actually in a ready state of operation. This illustrates that the high maintenance requirements, especially on aircraft that are more than four decades old, are creating great pressure on Depohar 10 and the supporting industries. The length of the maintenance cycle, compounded by the lead time of parts that can reach more than a year, suggests that Hercules readiness is highly vulnerable to global supply chain constraints. The limitation of maintenance facilities and test equipment also affects the effectiveness of heavy maintenance work, resulting in work queues that have an impact on low operational readiness values.

The interview findings also show that the quality and number of maintenance technicians play an important role in creating operational readiness. The high demands on competence in handling technological differences between C-130 variants, especially the significant differences between the older platform and the C-130J, created a need for ongoing training. The limitations of training that depend on foreign cooperation are a challenge in itself. This can be interpreted as an indication that operational readiness is not only a technical issue of maintenance, but also greatly influenced by human resource development policies that are able to keep up with the development of strategic transport aircraft technology.

From a strategic perspective, the readiness of the Hercules greatly determines the ability of the Indonesian Air Force to carry out the concept of layered air defense and national air mobility. When the number of aircraft ready for operation is low, the ability of the Indonesian Air Force to deploy troops, distribute radars, shift equipment, and logistical support to frontline bases is also affected. Thus, the operational readiness of the C-130 is not just a technical indicator, but a critical variable that affects the country's overall defense posture. This interpretation shows that Hercules readiness needs to be seen as a national strategic issue that requires policy intervention, industrial capacity building, and modernization of maintenance systems to ensure that the Indonesian Air Force can respond quickly and effectively to national threat dynamics.

From the perspective of Defense Theory, the operational readiness of the C-130 Hercules aircraft shows that the element of strategic mobility is a very fundamental component in Indonesia's air defense structure. The principle of force projection requires the Indonesian Air Force to be able to deploy forces quickly to areas prone to threats, both to strengthen air bases, deploy defense radars, and move troops and defense equipment in a short time. The findings show that when the number of aircraft ready for operation is limited due to age, lengthy maintenance, and spare parts barriers, the country's ability to respond directly to national threats also decreases. Thus, Hercules' readiness not only serves as a technical measure, but is part of a national defense strategy that affects Indonesia's deterrence in the Indo-Pacific region.

Judging from Defense Management Theory, the readiness condition of Hercules reflects the effectiveness of defense resource management, including policies, budgets, supply chains, human resources, and maintenance facilities. This theory asserts that the success of a defense

organization is determined by the managerial ability to plan, organize, direct, coordinate, and supervise all components involved. Data analysis shows that various readiness constraints such as the limited hangar capacity of Depohar 10, high dependence on foreign vendors, the length of the parts procurement process, and the lack of technician training to deal with modern avionics are indicators of the existence of room for improvement in the defense management system. These obstacles confirm that operational readiness is not only shaped by technical elements, but is a consequence of defense governance that is not yet fully optimal.

From the perspective of Readiness Theory, the results of the study show that Hercules readiness is the outcome of four core variables: material conditions, personnel competence, logistics availability, and maintenance system effectiveness. Field findings show that readiness is greatly influenced by the age of the aircraft, the level of structural fatigue, the limitation of spare parts, and the variation in technician competence in handling technological differences between the old C-130 and C-130J variants. Unstable readiness creates a maintenance backlog and causes some aircraft to be unable to be deployed, thereby reducing the operational flexibility of the Indonesian Air Force. This confirms that readiness is a dynamic variable that requires continuous support from all organizational systems.

Based on the results of the analysis, it can be concluded that the operational readiness of the C-130 Hercules aircraft is a decisive factor in the effectiveness of Indonesia's air defense system, especially in supporting strategic mobility, deployment of defense assets, and rapid response to national threats. Empirical findings show that readiness is influenced by a combination of technical factors such as aircraft age, material conditions, and spare parts availability as well as managerial factors, including the effectiveness of maintenance management, MRO facility capacity, technician competence, and defense logistics policies. Analysis based on defense theory, defense management, and readiness theory shows that Hercules readiness is not only a technical maintenance issue, but an integral part of the country's broader defense strategy. Overall, the sub-optimal readiness conditions reflect the need to improve maintenance governance, strengthen the national defense industry, and modernize support systems so that the C-130 Hercules can optimally perform its role in maintaining national airspace and facing evolving security threats.

Analysis of the Strategic Role of Hercules Through the Triple Helix in Facing National Threats.

The strategic role of the C-130 Hercules aircraft in dealing with national security threats relies heavily on synergy between government, industry, and academia, as described in the Triple Helix model. The government, through the C-130J procurement policy, fleet revitalization, and maintenance budget allocation, plays a major role in strengthening strategic air mobility capacity. PT Dirgantara Indonesia supports the technical readiness of Hercules through maintenance, engineering, and component fabrication, although it still faces constraints related to dependence on parts imports and limitations of domestic MRO infrastructure. Academics play a role in the development of modern maintenance research, digital innovation, and the improvement of technical human resource competencies to support the efficiency and effectiveness of aircraft maintenance.

The C-130 Hercules plays a crucial role in Indonesia's three main air defense functions: the deployment of troops and equipment, the distribution of critical logistics, and humanitarian operations and evacuation in non-military threat scenarios. With its STOL capabilities, large

carrying capacity, and operational flexibility, Hercules is the ultimate platform for rapid response to threats, both military and non-military. This strategic role cannot run effectively without good coordination between government, industry, and academia. These three elements support each other in strengthening aircraft readiness and the ability of the Indonesian Air Force to face increasingly dynamic national threats.

This analysis shows that the sustainability of Hercules' strategic role as a strategic air mobility platform is largely determined by the quality of interaction between government, industry, and academia. This synergy strengthens Hercules' operational readiness, optimizes aircraft maintenance, and enables Indonesia to overcome military, non-military, and hybrid threats. By strengthening the Triple Helix ecosystem, Indonesia can ensure that the C-130 Hercules remain the backbone of air defense, maintain national stability, and support rapid responses to complex threats.

Research Findings

Based on the results of data collection, theoretical analysis, and in-depth interpretation of the operational readiness and strategic role of the C-130 Hercules aircraft, there are several research findings that illustrate the real conditions as well as challenges faced by the Indonesian Air Force in supporting the Indonesian air defense system. These findings generally confirm that the C-130 Hercules is a critical component that not only serves as a transport aircraft, but also as a key element that determines the effectiveness of Indonesia's response to various national security threats.

The first findings suggest that Hercules' operational readiness is still not at an ideal level. Although Indonesia has a significant number of fleets, only a few units are in a state of readiness for operation due to high maintenance needs, relatively old aircraft, and limited spare parts. This readiness is greatly influenced by the tiered maintenance cycle, Depohar 10 capacity, technician quality, and systemic dependence on international supply chains. These findings confirm that readiness is a multidimensional issue that is not only related to technical, but also managerial and policy aspects. This is in line with defense management theory that emphasizes the importance of effective defense resource management.

The second finding states that the strategic function of Hercules in air defense cannot run optimally without the support of the Triple Helix ecosystem. The government plays a role as a determinant of policy direction and budget provider; industry, especially PT Dirgantara Indonesia, is a pillar of structural maintenance and technical engineering; while academics contribute through innovative research and technical human resource development. The dependence on overseas vendors for critical components shows the need to increase the capacity of the national industry. This study also found that the involvement of academics still has the potential to be strengthened, especially in material research, predictive maintenance, and digital technology for aircraft maintenance.

The third finding shows that Hercules plays a strategic role in dealing with a spectrum of threats, ranging from military, non-military, to hybrid threats. In the context of Air Power, this aircraft is a force multiplier that allows the Indonesian Air Force to quickly project forces, strengthen border air bases, distribute defense radars, and provide large-scale logistical support. In the context of disasters, the Hercules became the most reliable state tool because it was able to land on a limited runway and carry large payloads. Thus, the existence of Hercules

strengthens national resilience while making an important contribution to the legitimacy of the government in responding to crises.

The overall synthesis shows that Hercules' operational readiness and strategic role are two aspects that affect each other and cannot be separated. Low readiness has a direct impact on reduced force projection and rapid response capabilities, while weak Triple Helix collaboration causes aircraft sustainment to be disrupted and hinders the optimization of its strategic role. Therefore, increasing the effectiveness of defense management, strengthening the Triple Helix ecosystem, and modernizing industrial capacity are important steps that must be taken to ensure that Hercules remains relevant and able to answer national security challenges in the future.

CONCLUSION

This research, drawing on theoretical analysis, field data, and interviews with key informants, concluded that the C-130 Hercules aircraft played a crucial strategic role in supporting Indonesia's air defense through troop mobilization and responses to non-military threats, despite operational readiness being hampered by technical, logistical, and managerial issues such as intensive maintenance needs, aging fleets, and limited imported parts. The Indonesian Air Force's tiered maintenance system and revitalization programs demonstrated ongoing efforts to sustain the Hercules as a key mobility asset, while Triple Helix synergy among government, industry (PT Dirgantara Indonesia), and academia proved highly effective in optimization. Strengthening this collaboration, enhancing maintenance governance, and building national defense industry capacity emerged as essential steps to ensure the Hercules's readiness for future security challenges. For future research, scholars could quantitatively assess the cost-benefit impacts of Triple Helix-driven modernization on C-130J procurement and digital maintenance technologies to inform scalable policy frameworks.

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