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Indonesian Air Force Transformation Strategy Towards Multi-Domain Operations (MDO) Through Adapting The Asian Country Model To Face Modern Warfare

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Abstract: The development of the global strategic environment and the changing character of modern warfare have driven the transformation of the concept of military operations from a single-domain approach to Multi-Domain Operations (MDO) that integrates land, sea, air, cyber, space, and electromagnetic spectrum domains to create decision advantage. This condition requires the Indonesian Air Force (TNI AU) to undergo transformation to be able to face increasingly complex multidimensional threats in the Indo-Pacific region and the national strategic environment. This study aims to formulate a strategy and roadmap for the TNI AU's transformation towards MDO by adapting the model of Asian countries, especially Japan, South Korea, Singapore, and India. The study uses qualitative methods with a descriptive-analytical approach as well as conceptual, comparative, and strategic approaches through literature studies on military doctrine, defense policies, regulations, and related literature. The results of the study indicate that the TNI AU has an initial foundation towards multi-domain operations through the development of the CAKRA Air Force Defense System concept, strengthening the Koopsudnas organization, developing Tactical Data Links, cyber and space capabilities, and implementing Network Centric Warfare. However, this transformation still faces several challenges, such as the lack of an operational definition of MDO that suits Indonesia's characteristics, limited interoperability between systems, the need to strengthen C4ISR/C5ISR/C6ISR capabilities, the readiness of multi-domain human resources, and the strengthening of the national defense industry. This study concludes that the transformation of the Indonesian Air Force towards MDO needs to be implemented in stages through adaptation

of best practices from Asian countries while still considering Indonesia's geographical characteristics, the total defense system, and national defense interests in order to realize an air force that is integrated, adaptive, and ready to face modern warfare.

Keywords: Adaptation of the Asian Country Model, Air Defense, Decision Advantage, Indonesian Air Force Transformation, Interoperability, Modern Warfare, Multi Domain Operations (MDO), Multidomain Operations

INTRODUCTION

The development of the global strategic environment in the 21st century has shown significant changes in the character of warfare. While during the World Wars and the Cold War, conflicts were dominated by the use of conventional military force in the land, sea, and air domains, modern warfare has become more complex, involving cyberspace, space, the electromagnetic spectrum, information, and digital technology. The use of artificial intelligence (AI), unmanned systems, satellites, big data, cloud computing, and high-speed communication networks have become essential components of modern military operations (Builder, 1989). According to (Hoffman, 2007), contemporary conflict has evolved into hybrid warfare, combining conventional military operations, information warfare, cyber operations, economic pressure, and psychological operations simultaneously to achieve strategic objectives. Accordingly, the United States Department of Defense emphasizes that the success of future military operations will be largely determined by the ability to integrate all operational domains to create a decision advantage or the ability to make decisions more quickly than the opponent (US Department of Defense, 2022).

This changing character of warfare is evident in various modern conflicts. The Russia–Ukraine conflict demonstrated the importance of integrating drones, commercial satellites, electronic warfare, cyber operations, and real-time, connected command and control systems (IISS, 2025). The Israel and Hamas conflict also demonstrated that integrated sensors, layered air defense systems, and electronic warfare capabilities are key factors in maintaining strategic superiority (IISS, 2025). This situation demonstrates that the success of modern military operations is no longer determined by the quantity of defense equipment alone, but by the ability to integrate various operational domains within a single, connected system. In response to these developments, the concept of Multi-Domain Operations (MDO) has developed as a new paradigm that emphasizes the integration of land, sea, air, cyber, space, and electromagnetic spectrum domains to produce integrated and synchronized operational effects (TRADOC, 2018).

The changing nature of global warfare is also influencing the security dynamics of the Indo-Pacific region. This region has become the world's geopolitical center of gravity, supporting more than 60 percent of global economic activity through strategic international trade routes (UNCTAD, 2024). Competition between the United States and China, disputes over the South China Sea, tensions in the Taiwan Strait, and the military modernization of regional countries have increased the complexity of the regional security environment (IISS, 2025). The Military Balance 2025 report shows that the Indo-Pacific is the region with the fastest rate of military modernization in the world, marked by increasing defense budgets, the development of advanced weapons systems, and significant investments in cyber and space capabilities (IISS, 2025). Furthermore, Asian countries continue to increase defense spending in response to the growing uncertainty in the region's strategic environment (SIPRI, 2025).

In response to these challenges, several Asian countries have undertaken military transformations toward multi-domain operations. Japan developed the Cross-Domain Operations concept, integrating land, sea, air, cyber, space, and electromagnetic spectrum

capabilities (Japan Ministry of Defense, 2024). South Korea, through its Defense Innovation 4.0 program, is developing a military force based on artificial intelligence, big data, and unmanned systems (Republic of Korea Ministry of National Defense, 2024). Singapore established a Digital and Intelligence Service focused on cyber, digital, information, and intelligence operations (Singapore Ministry of Defense, 2024), while India developed Integrated Theater Commands to enhance interoperability in joint operations (Indian Ministry of Defense, 2024). The experiences of these countries demonstrate that the transformation toward MDO encompasses not only the modernization of defense equipment but also changes in doctrine, organization, human resources, technology, and the defense industry.

For Indonesia, these changes in the strategic environment have significant implications. As the world's largest archipelagic nation, strategically positioned at the intersection of the Indian and Pacific Oceans, Indonesia faces increasingly complex, multidimensional threats (Law of the Republic of Indonesia No. 43 of 2008). These threats encompass not only conventional military threats but also cyber threats, information warfare, satellite system disruption, airspace violations, and electronic warfare (Ministry of Defense of the Republic of Indonesia, 2023). Therefore, the national defense system must be able to adapt to the development of multidomain threats, as mandated by Law No. 3 of 2002 concerning National Defense.

In this context, the Indonesian Air Force (TNI AU) plays a strategic role as the main component of national defense in the air sector (Law of the Republic of Indonesia No. 34 of 2004). Various modernization programs have been implemented through the development of Koopsudnas, strengthening the national radar system, building cyber and space capabilities, developing Tactical Data Links, and drafting the CAKRA Air Force Defense System concept (Mabesau, 2024). This concept demonstrates the initial foundation for multi-domain operations through the integration of air, cyber, space, and electronic warfare capabilities supported by the Network Centric Warfare and AI-Assisted OODA Loop concepts (Koopsudnas, 2025). However, the transformation towards MDO still faces various challenges, including the lack of an operational concept that suits Indonesia's characteristics, limited interoperability between platforms, and the need to strengthen C4ISR, cyber, space, and electronic warfare capabilities (NATO, 2023; US Air Force, 2023). In addition, the readiness of multi-domain human resources and the independence of the national defense industry also still require continuous development (Freeman, 1987).

Based on these conditions, the Indonesian Air Force's transformation towards Multi-Domain Operations is a strategic necessity that cannot be postponed. However, this transformation must be carried out through adaptation of Asian countries' models tailored to Indonesia's geographical characteristics, overall defense system, and national resources. Therefore, this study focuses on the Indonesian Air Force's transformation strategy towards MDO through adaptation of Asian countries' models to face modern warfare. This study aims to formulate an operational definition of MDO appropriate for the Indonesian Air Force, identify best practices that can be adapted from Asian countries, and develop policy directions and a roadmap for transformation towards an air force that is integrated, adaptive, and interoperable, and capable of effectively facing the challenges of modern warfare.

METHOD

This study uses a qualitative research method with a descriptive-analytical approach to examine the concept of Multi Domain Operations (MDO), its implementation models in several Asian countries, and its relevance to the transformation of the Indonesian Air Force in facing modern warfare. The qualitative method was chosen because it is able to provide a deep understanding of strategic phenomena, the dynamics of the security environment, and the transformation of military organizations that are complex and multidimensional. The

approaches used include a conceptual approach, a comparative approach, and a strategic approach. The conceptual approach is used to analyze various concepts and definitions of MDO that have developed in modern defense doctrine and literature in order to formulate an operational definition that suits the characteristics, tasks, and needs of the Indonesian Air Force. The comparative approach is used to compare the MDO models implemented by Japan, South Korea, Singapore, and India to identify best practices that can be adapted. Meanwhile, a strategic approach is used to analyze the actual conditions of the Indonesian Air Force, identify gaps between existing capabilities and the ideal needs of multidomain operations, and formulate the necessary transformation strategies and roadmaps. Data collection was carried out through literature studies utilizing various primary and secondary sources, such as military doctrine, defense policies, books, scientific journals, reports from international institutions, national regulations, and other relevant documents. The data obtained were then analyzed qualitatively through the stages of data reduction, data presentation, comparative analysis, gap analysis, and drawing conclusions as a basis for formulating strategies and roadmaps for the transformation of the Indonesian Air Force towards Multi Domain Operations through adapting the model of Asian countries to face modern warfare.

RESULTS AND DISCUSSION

This research shows that the Indonesian Air Force (TNI AU) already has a number of tools that can be the foundation of transformation towards Multi Domain Operations (MDO), including the concept of the CAKRA Air Force Defense System, Koopsudnas and Kodau organizations, command and control systems, radar and sensor networks, manned and unmanned aerial platforms, air defense systems, Tactical Data Link (TDL) development, cyber and space capabilities, electronic warfare equipment, air base networks, national defense industry, and human resource development and training systems. However, the facts show that the TNI AU's MDO capabilities are still in the development and transition phase. Although various tools are available, cross-domain integration, interoperability between systems, real-time data exchange, strengthening C4ISR/C5ISR/C6ISR, network resilience, cyber and space capabilities, and multidomain operations culture still require further development. The main challenges faced include the lack of a standard operational definition of MDO in the national context, limited interoperability of platforms from various producing countries, the ongoing development of TDL and Network Centric Warfare, suboptimal counter-UAS capabilities, and the need to improve defense industry synergy and human resource quality. Furthermore, the success of the MDO transformation is highly dependent on policy support, sustainable funding, and cross-institutional collaboration. Thus, these conditions indicate that the Indonesian Air Force (TNI AU) has sufficient initial capital to develop MDO, but there is still a gap between actual and ideal capabilities that needs to be addressed through a planned, gradual, and sustainable transformation strategy.

This research produces a number of findings and discussions obtained through an in-depth data analysis process based on a theoretical framework, observation results, document studies, and studies of various relevant references, so as to provide a comprehensive picture of the transformation of the Indonesian Air Force towards Multi Domain Operations in facing the increasingly complex and multidimensional characteristics of modern warfare.

1. Operational Definition of Multi Domain Operations that is in Accordance with the Characteristics, Duties, and Needs of the Indonesian Air Force in Facing Modern Warfare

The research results show that Multi Domain Operations (MDO) for the Indonesian Air Force is an operational concept that integrates and converges capabilities from the air, land, sea, cyber, space, information, and electromagnetic spectrum domains to generate information superiority and decision-making advantage. This finding is in line with the

MDO concept developed by TRADOC (2018), which emphasizes that victory in modern conflict is no longer determined by dominance in one domain, but by the ability to integrate all domains simultaneously to create operational dilemmas for the opponent. From a strategic perspective, Gray (2010) explains that strategic success is largely determined by the balance between ends, ways, and means. Therefore, the implementation of MDO in the Indonesian Air Force is not only oriented towards modernizing defense equipment, but also on the integration of doctrine, organization, human resources, technology, and command and control systems. This finding also reinforces the view of Murray and Knox (2001) that military transformation must include comprehensive changes to the way military organizations think, build forces, and conduct operations. Thus, the operational definition of the Indonesian Air Force's MDO is a form of adaptation of the global concept that is adjusted to the characteristics of Indonesia as an archipelagic country and the needs of the Indonesian Air Force's joint operations.



Figure 1. MDO Definition Formulation Flow

2. The Multi-Domain Operations Transformation Model of Asian Countries and Its Relevance to the Needs of the Indonesian Air Force

The research findings show that Japan, South Korea, Singapore, and India have developed different Multi-Domain Operations transformation models according to the characteristics of their respective strategic environments. Japan emphasizes the integration of air, space, cyber, and the electromagnetic spectrum through the concept of Cross-Domain Operations (Japan Ministry of Defense, 2024). South Korea is developing Defense Innovation 4.0, which focuses on the utilization of artificial intelligence, unmanned systems, and digital transformation of defense (Ministry of National Defense of the Republic of Korea, 2023). Singapore is prioritizing the integration of intelligence, digital, and cyber through the establishment of the Digital and Intelligence Service (Singapore Ministry of Defense, 2022), while India is developing the Joint Doctrine for Multi-Domain Operations, which emphasizes jointness and interoperability across the various branches

(Headquarters Integrated Defense Staff India, 2023). These findings support the policy adaptation theory proposed by Dolowitz and Marsh (2000), which states that the success of organizational transformation is not determined by the ability to imitate other countries' models, but by the ability to adapt best practices to national needs. Therefore, the most relevant transformation model for the Indonesian Air Force is not a single model, but rather a combination model that integrates Japan's strengths in air-space integration, South Korea's in technological innovation, Singapore's in digital and intelligence integration, and India's in strengthening joint operations.

Table 1 Comparison of Multi-Domain Operations Transformation Models of Asian Countries and Their Relevance to the Needs of the Indonesian Air Force

N o.	Country	Transformation Concept/Model	Main Focus of Transformation	Main Characteristics	Relevance to the Indonesian Air Force	Adaptable Elements
1	2	3	4	5	6	7
1.	Japan	<i>Cross-Domain Operations</i> and Multi-Domain Defense Force.	Integration of land, sea, air, space, cyber and electromagnetic spectrum capabilities	Japan places space, cyberspace, and the electromagnetic spectrum at the heart of its modern defense system. Defense development focuses on integrated air and missile defense, space situational awareness, cyber defense, and electromagnetic warfare.	This is relevant for the Indonesian Air Force (TNI AU) because Indonesia and Japan share the characteristics of archipelagic nations, requiring integrated air and maritime surveillance. The Japanese model can serve as a learning tool for developing air-space integration, early warning systems, layered air defenses, and strengthening cyber and space domains.	Strengthening Integrated Air Defense, Cyber and Space, Electromagnetic Warfare, air and space integration, early warning systems, and layered air defense within the CAKRA framework.
2.	South Korea	<i>Defense Innovation 4.0</i> .	Defense transformation based on artificial intelligence, big data, unmanned systems, robotics, manned-unmanned teaming, and the defense industry.	South Korea emphasizes developing a science and technology-based military. The transformation is aimed not only at modernizing defense equipment but also at mastering technology, smart command and control, the defense industry, and AI-based combat systems.	Relevant for the Indonesian Air Force (TNI AU) in developing UAV/UCAV, AI-assisted OODA Loop, data fusion, predictive maintenance, smart logistics, cyber capability, and strengthening the national defense industry. This model supports the shift from platform-oriented planning to system and capability-based planning.	Strengthening AI-assisted decision making, UAV/UCAV, manned-unmanned teaming, data fusion, predictive maintenance, smart logistics, and the development of the national defense industry as part of the MDO ecosystem.
3.	Singapore	<i>Digital and Intelligence Services</i> and the Digital-Intelligence-Cyber Integration approach.	Integration of digital, intelligence, cyber, information, data, and	Singapore positions the digital, cyber, intelligence, and information domains as strategic elements of national defense. This model	Relevant for the Indonesian Air Force (TNI AU) in developing C4ISR/C5ISR/C6ISR, a common operational picture, data	Strengthening C4ISR/C5ISR/C6ISR, data fusion, cyber defense, intelligence integration,

			command and control.	emphasizes network-centric operations, C4I/C4ISR, data integration, human resource quality, and critical infrastructure protection.	management, cyber defense, intelligence fusion, and decision support systems. The Singapore model teaches us that human resource quality and data integration are crucial factors in building decision-making excellence.	decision support systems, and the formation of human resources with digital, cyber, and data analysis capabilities.
4.	India	<i>Integrated Theater Commands</i> and Joint Doctrine for Multi Domain Operations.	Strengthening jointness, interoperability, joint command, cross-dimensional integration, and the development of cyber, space, and cognitive domains.	India faces challenges of a vast territory, multi-domain threats, and multi-origin defense equipment. The transformation is aimed at command integration, standardization of procedures, strengthening joint operations, and interoperability across the military and military branches.	This is relevant for the Indonesian Air Force (TNI AU) because Indonesia also has a vast territory, complex geography, and multi-origin defense equipment. The Indian model can be a learning experience in building interoperability across the military's branches, gateway systems, data standardization, and a common operational picture in joint TNI operations.	Strengthening jointness, integrated command and control, multi-origin platform interoperability, gateway systems, TTP standardization, and integration of the Indonesian Air Force with the Indonesian Army, Indonesian Navy, Kogabwilhan, Koopsudnas, and Kohanudnas.

3. The Indonesian Air Force's Roadmap for Transformation Towards Multi-Domain Operations through Adaptation of Asian Countries' Models to Face Modern Warfare

The research findings indicate that the Indonesian Air Force's transformation towards Multi-Domain Operations needs to be implemented in stages through three main phases: the conceptual foundation and initial integration phase, the capability integration and interoperability phase across the service branches, and the full operationalization of MDO. This finding aligns with Murray and Knox's (2001) military transformation theory, which states that military transformation is a long-term evolutionary process encompassing changes in doctrine, organization, technology, and organizational culture. In the initial phase, priorities are directed toward developing an operational definition of MDO, developing doctrine, and building a C4ISR/C5ISR/C6ISR architecture. The second phase focuses on the integration of the Tactical Data Link, the common operational picture, and interoperability across the service branches. Furthermore, the third phase is directed toward the full operationalization of MDO, capable of generating decision advantages through the integration of all operational domains. From a strategic perspective, Gray (2010) emphasized that force development must be carried out in stages, taking into account the alignment between objectives, methods, and available resources. Therefore, the roadmap for the Indonesian Air Force's transformation towards MDO must be implemented in a comprehensive manner, realistic, adaptive, and sustainable according to national defense needs.

4. SWOT and TOWS Matrix Analysis of the Indonesian Air Force's Transformation Towards Multi-Domain Operations

The SWOT analysis shows that the Indonesian Air Force (TNI AU) possesses strengths in the form of the CAKRA National Air Defense System concept, an organizational structure that supports integrated air operations, and the development of cyber, space, and electronic warfare capabilities. However, several weaknesses remain, such as the lack of a standard operational definition of MDO, limited interoperability of multi-origin platforms, and the ongoing development of Tactical Data Link and C6ISR. Externally, opportunities arise through the development of digital technology, artificial intelligence, and learning from the transformation models of Asian countries. Conversely, threats stem from the increasing complexity of modern warfare involving cyber attacks, information warfare, satellite disruption, and unmanned systems. Based on the TOWS Matrix approach developed by Weihrich (1982), the TNI AU is positioned in the WT quadrant, indicating the need for a defensive-adaptive strategy. This strategy focuses on reducing internal weaknesses to enhance capabilities in facing external threats. These findings suggest that the TNI AU's transformation priorities should be directed towards developing an MDO doctrine, strengthening interoperability, developing a C6ISR system, enhancing cyber and space capabilities, and developing human resources. multidomain human resources.



Figure 2. MDO Definition Formulation Flow

Table 2 SWOT Analysis of the Indonesian Air Force's Transformation Towards Multi-Domain Operations

SWOT	Factor	Description
1	2	3
Strength	S1	The Indonesian Air Force has the concept of the National Air Defense System "CAKRA" as the operational embryo of MDO.
	S2	The Indonesian Air Force has a structure of Koopsudnas, Kodau, Kohanudnas, Puskodal, Pusdalops, Radar Unit, Lanud, as well as electronic communication elements that can be developed to support multi-domain operations.

	S3	The Indonesian Air Force already has initial equipment in the form of radar, fighter jets, transport aircraft, UAV/UCAV, air defense systems, and the development of Tactical Data Links.
	S4	The Indonesian Air Force (TNI AU) has begun developing cyber, space, and electronic warfare capabilities as part of the needs of modern warfare.
	S5	The Indonesian Air Force has a personnel education, training, and development system that can be directed to form digital warriors, fighter intellects, planners, strategic thinkers, and strategic leaders.
	S6	Indonesia has a national defense industry that can support the MDO transformation, including PT Dirgantara Indonesia, PT Len Industri, PT Infoglobal, PT Sari Bahari, and PT Dahana.
Weakness	W1	There is no standard operational definition of the Indonesian Air Force's MDO as a basis for doctrine, organization, training, force development, and budgeting.
	W2	Multi-origin platform interoperability is not optimal due to differences in operating systems, data links, digital languages, communication systems, and security standards.
	W3	Tactical Data Link, Network Centric Warfare, C4ISR/C5ISR/C6ISR, and the common operational picture are still under development.
	W4	Cyber, space, and electronic warfare capabilities are still embryonic and not yet fully integrated into air operations.
	W5	A multi-domain operating culture has not yet been fully established evenly across all levels of the organization.
	W6	The national defense industry has not yet fully assumed the role of a multi-domain air defense system integrator.
1	2	3
Opportunity	O1	The cross-domain operational models of Japan, South Korea, Singapore, and India can be used as lessons in formulating the Indonesian Air Force's MDO transformation.
	O2	The development of artificial intelligence, big data, cloud computing, unmanned systems, satellites, cyber defense, electronic warfare, and data analytics opens up opportunities to accelerate MDO transformation.
	O3	Indonesia's strategic position in the Indo-Pacific region provides an opportunity for the Indonesian Air Force to strengthen its role in the national defense system.
	O4	Opportunities for defense cooperation, transfer of technology, transfer of knowledge, joint development, and joint production can be utilized to accelerate mastery of MDO technology.
	O5	Increasing national awareness of the importance of defense modernization can be the basis for strengthening policies, budget support, and collaboration across ministries/agencies.
Threat	T1	Great power competition in the Indo-Pacific, the South China Sea dispute, and potential regional escalation could impact Indonesia's national security.

	T2	Modern warfare threats include airspace violations, cyber attacks, information warfare, jamming, spoofing, denial of communications, satellite disruption, and electronic warfare.
	T3	The threat of drones, swarm drones, loitering munitions, precision missiles, and unmanned systems is increasing in modern conflicts.
	T4	Reliance on digital systems, satellites, data links, and communications networks can become vulnerable if attacked or disrupted by an adversary.
	T5	Budget constraints, technology embargoes, foreign dependency, and global supply chain disruptions can hinder MDO transformation.

Table 3 TOWS Matrix: The Indonesian Air Force's Transformation Towards MDO

		INTERNAL (S/W)	STRENGTHS	WEAKNESSES
EKSTERNAL (O/T)			1. Konsep Sistem Pertahanan Matra Udara "CAKRA" sebagai embrio operasional MDO. 2. Struktur Koopsudnas, Kodau, Kohanudnas, Puskodal, Pusdalops, Satuan Radar, Lanud, dan unsur komunikasi-elektronika. 3. Perangkat awal: radar, pesawat tempur, pesawat angkut, UAV/UCAV, sistem pertahanan udara, dan pengembangan Tactical Data Link. 4. Embrio kemampuan siber, antariksa, dan peperangan elektronika. 5. Sistem pendidikan, latihan, dan pembinaan personel menuju digital warrior dan fighter intellect. 6. Dukungan industri pertahanan nasional: PT DI, PT Len, PT Infoglobal, PT Sari Bahari, PT Dahana.	1. Belum ada definisi operasional MDO TNI AU yang baku. 2. Interoperabilitas platform multi-origin belum optimal. 3. Tactical Data Link, NCW, C4ISR/C5ISR/C6ISR, dan common operational picture masih berkembang. 4. Kemampuan siber, antariksa, dan peperangan elektronika masih embrionik. 5. Budaya operasi multidomain belum terbentuk merata. 6. Industri pertahanan nasional belum sepenuhnya menjadi integrator sistem.
		OPPORTUNITIES 1. Model operasi lintas domain Jepang, Korea Selatan, Singapura, dan India dapat dijadikan pembelajaran. 2. Perkembangan AI, big data, cloud computing, unmanned system, satelit, cyber defense, electronic warfare, dan data analytics. 3. Posisi strategis Indonesia di Indo-Pasifik memperkuat peran TNI AU. 4. Peluang kerja sama pertahanan, transfer of technology, transfer of knowledge, joint development, dan joint production. 5. Meningkatnya kesadaran nasional terhadap pentingnya modernisasi pertahanan.	- SO-1. Mengembangkan CAKRA menjadi arsitektur operasional MDO TNI AU. - SO-2. Mempercepat pembangunan Tactical Data Link dan C4ISR/C5ISR/C6ISR. - SO-3. Mendorong penguatan air-space-cyber-electromagnetic capability. - SO-4. Memperkuat industri pertahanan nasional dalam ekosistem MDO.	- WO-1. Merumuskan definisi operasional MDO TNI AU berbasis pembelajaran negara Asia. - WO-2. Menyusun doktrin dan pedoman operasi multidomain TNI AU. - WO-3. Mengembangkan gateway system dan standarisasi data. - WO-4. Membangun SDM multidomain melalui pendidikan dan latihan berbasis teknologi.
		THREATS 1. Kompetisi kekuatan besar di Indo-Pasifik dan potensi eskalasi kawasan. 2. Ancaman perang modern: pelanggaran wilayah udara, serangan siber, perang informasi, jamming, spoofing, denial of communications, gangguan satelit, dan electronic warfare. 3. Ancaman drone, swarm drone, loitering munition, rudal presisi, dan sistem tanpa awak. 4. Ketergantungan pada sistem digital, satelit, data link, dan jaringan komunikasi menjadi kerentanan. 5. Keterbatasan anggaran, embargo teknologi, ketergantungan luar negeri, dan gangguan rantai pasok global.	- ST-1. Memperkuat integrated air surveillance dan layered air defense. - ST-2. Mengembangkan counter-UAS dan electronic warfare sebagai bagian dari CAKRA. - ST-3. Meningkatkan cyber resilience dan kemampuan operasi dalam degraded environment. - ST-4. Mengoptimalkan Koopsudnas, Kodau, Kohanudnas, dan Lanud sebagai simpul respons cepat.	- WT-1. Menyusun roadmap transformasi MDO secara bertahap dan berbasis prioritas. - WT-2. Memprioritaskan integrasi sistem dibanding pengadaan platform semata. - WT-3. Memperkuat keamanan siber, komunikasi alternatif, dan redundansi sistem. - WT-4. Mendorong industri pertahanan nasional sebagai integrator sistem.

5. Indicators of Success of the Indonesian Air Force's Transformation Towards Multi-Domain Operations

The research results indicate that the success of the Indonesian Air Force (TNI AU)'s transformation towards Multi-Domain Operations must be measured multidimensionally and not solely based on the procurement of defense equipment. This finding aligns with Murray and Knox's (2001) military transformation theory, which asserts that successful transformation is determined by integrated changes in doctrine, organization, technology, and human resources. In the doctrinal aspect, success is indicated by the formulation of operational definitions and the TNI AU's MDO doctrine. In the technological aspect, success is indicated by the integrated functioning of the Tactical Data Link, C4ISR/C5ISR/C6ISR, and the common operational picture (Alberts & Garstka, 1999). In the interoperability aspect, success is indicated by the ability to exchange data across the military in real time and securely. In the human resources aspect, success is indicated by the formation of personnel with multi-domain competencies, cyber awareness, space awareness, and data-based decision-making capabilities. Furthermore, in the defense industry aspect, success is indicated by the increasing capability of the national industry as

an integrator of multi-domain air defense systems. Overall, the main indicator of success of transformation is the achievement of information superiority and decision advantage as explained in the MDO concept by TRADOC (2018) and the OODA Loop theory developed by Boyd (1987).

CONCLUSION

This research produces three main conclusions. First, Multi Domain Operations (MDO) for the Indonesian Air Force is defined as an operational concept that integrates the capabilities and effects of the air, cyber, space, information, maritime, land, and electromagnetic spectrum domains through the support of C4ISR/C5ISR/C6ISR systems, Tactical Data Link, Network Centric Warfare, and Common Operational Picture to create information superiority, decision advantage, and integrated operational effects in maintaining airspace sovereignty and supporting joint TNI operations. This concept places cross-domain integration as the main focus, adapted to the characteristics of Indonesia as an archipelagic nation and a universal defense system.

Second, the analysis of the MDO transformation models in Japan, South Korea, Singapore, and India shows that each country has advantages that can serve as references for the Indonesian Air Force. Japan emphasizes cross-domain integration through Cross-Domain Operations, South Korea is developing transformation based on artificial intelligence and unmanned systems, Singapore focuses on digital, cyber, and intelligence integration, while India emphasizes interoperability through Integrated Theater Commands. Therefore, the most relevant approach for the Indonesian Air Force is not to adopt a single model in its entirety, but rather to adapt and combine the best practices of each country according to Indonesia's national defense needs, geographic conditions, and resource capabilities.

Third, the Indonesian Air Force's transformation towards MDO needs to be implemented in stages through three main phases: building conceptual and institutional foundations, integrating multi-domain capabilities, and fully operationalizing them within the framework of joint TNI operations. To support this process, policies are needed that include the development of MDO doctrine, strengthening CAKRA as the embryo of multi-domain operations, developing C4ISR/C5ISR/C6ISR, Tactical Data Link, cyber, space, and electronic warfare capabilities, improving the quality of human resources, and strengthening the national defense industry. With these steps, the Indonesian Air Force is expected to be able to realize an air force that is integrated, adaptive, interoperable, and ready to face the challenges of modern warfare in the Indo-Pacific region.

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