

Comparative Analysis Of A Multi-Layered Weapon System For City Air Defense In The Modern Warfare

Khoerozadi Faizal Iman^{1)*}, Robertus Heru Triharjanto²⁾, Heri Budi Wibowo³⁾, Yayat Ruyat⁴⁾
^{1,2,3,4)}Department of Weaponry Technology, Faculty of Defense Science and Technology, Republic of Indonesia
Defense University

*Corresponding Author

Email: khoerozadi.iman@tp.idu.ac.id

Abstract

In the era of modern warfare, urban defense is a very important aspect to maintain the security and stability of a country. Because modern war is a non-military war in which developed countries and foreign countries try to destroy a country through ideological, political, social, cultural and security defense. To protect the territory with effective air defense, it takes a strong and sophisticated defense resources with a reliable range of surveillance and agility to destroy any effort that threatens the security and sovereignty of the country. To achieve the objective of building a more efficient air defense system and functioning alongside other air defense platforms, new ideas and thinking are needed for program planning and the requirements of medium-range missile systems when building an air defense system. The research method used in this research is descriptive qualitative through a literature study. In the literature review, it is necessary to conduct a thorough search to ensure that the literature sources used are truly relevant to the research topic and a comparative analysis approach is used. In the realm of analyzing layered weapon systems, such as Hisar O, Hisar A, Korkut Gun System, Iron Dome, and NASAMS, it becomes imperative to delve into the comparative analysis and interpret the implications of their similarities and differences. Hisar O, a sophisticated air defense system, showcases advanced capabilities designed to counter aerial threats. Its cutting-edge technology and robust infrastructure provide a formidable defense mechanism. On the other hand, Hisar A, another component of the layered defense, excels in short-range air defense, ensuring effective protection against low-altitude aerial targets. Korkut Gun System, presents a unique blend of artillery and air defense capabilities. Its adaptable nature allows it to provide ground forces with enhanced protection against a wide range of threats. Iron Dome system has gained international recognition for its exceptional performance in countering short-range rocket threats. This innovative system incorporates advanced tracking and interception technologies, enabling it to neutralize incoming projectiles with a high success rate. NASAMS (National Advanced Surface-to-Air Missile System) stands out as a versatile air defense solution. Its state-of-the-art radar and missile technologies ensure reliable protection against a variety of airborne threats, including aircraft, helicopters, and unmanned aerial vehicles (UAVs). Now, let's delve into the implications of these comparative analyses for Indonesia. By understanding the strengths and weaknesses of each system, Indonesian defense strategists can make informed decisions regarding their defense capabilities. This analysis assists in identifying potential gaps in the country's air defense network and formulating strategies to address them effectively. In conclusion, through a comparative analysis of layered weapon systems such as Hisar O, Hisar A, Korkut Gun System, Iron Dome, and NASAMS, we gain valuable insights into their capabilities and implications. Evaluating differences and similarities, can help Indonesian defense planners make informed decisions to strengthen city air defense systems in the modern warfare.

Keywords: *Medium Range Missile, Iron Dome, NASAMS, Hisar O.*

INTRODUCTION

In the era of modern warfare, urban defense is a very important aspect to maintain the security and stability of a country. Because modern war is a non-military war in which developed countries and foreign countries try to destroy a country through ideological, political, social,

cultural and security defense (Hendra, et al, 2021). Threats to major cities are increasing along with technological developments and the complexity of existing threats. Amid the increasing complexity of threats, the arms race among Southeast Asian regional countries, and the escalation of piracy, smuggling, and terrorism cases (including border issues), the governing government must more actively consider the perspectives and readings of security actors and remain consistent in maintaining sovereignty, population, and territory (Azzqy & Puspitasari, 2020). Therefore, a weapon system capable of protecting cities from air threats is one of the things that is indispensable. Because air power can counter and attack from the enemy's center of gravity.

For the survival of the nation, the Republic of Indonesia must control its airspace. Air Defense Operations is a joint TNI operation that is carried out regularly, both in peacetime and wartime, with the Air Defense element as the main force and assisted by elements of the Armed Forces and civilian agencies that have air defense capabilities (Skep/163/V/2003).

Protecting national airspace from the threat of missile attacks and aircraft threatening national security is essential in view of the threats that exist at the regional and global levels. To protect the territory with effective air defense, it takes a strong and sophisticated defense resources with a reliable range of surveillance and agility to destroy any effort that threatens the security and sovereignty of the country. (Nugraha, 2019).

There has been an imbalance in the fulfillment of the element of medium-range missiles since the launch of the current air defense weapons system. Besides, given the current potential threat of not only air missile attacks but also cruise missiles and ballistic missiles, To meet the current terminal air defense system shortcomings, Kohanudnas must urgently build a medium-range air defense system. To achieve the objective of building a more efficient air defense system and functioning alongside other air defense platforms, new ideas and thinking are needed for program planning and the requirements of medium-range missile systems when building an air defense system. (Nugraha, 2019).

According to J.C. Cooper and Schatcer's Air Sovereignty Theory, which basically states that the airspace is not free, a state has sovereignties over the airspace that belongs to its territory. Based on the principle that "every state shall have full and complete sovereignty over the airspace above its territory," the establishment of the boundaries of the airspace is of paramount importance as it relates to a state's sovereignty over its airspace above its own territory. (Priyatna, 1972).

The Defense in Depth theory describes a layered defense pattern that allows the defense system to carry out sustained and coordinated resistance against any threat from the enemy. Kohanudnas adopted this pattern in organizing the operational mechanisms of the defense system, which is divided into several layers based on the capabilities of the weapons system it possesses, such as air defenses of areas, terminals, and points. (Kemhan, 2015). Based on the theory developed by Kohanudnas for National Air Defense, this research was conducted to add and dig into insights into layered weapons systems that can be applied to the city territory of Indonesia.

RESEARCH METHODS

The research method used in this research is descriptive qualitative through a literature study. The literature review research method is one of the research methods commonly used in scientific journals. This method is carried out by collecting and analyzing data from various library sources related to the research topic (Jaya, 2020). The area of medium-range layered air

weapon systems with a maximum range of 80 Km or for city areas in Indonesia is a research limitation.

In the literature review, it is necessary to conduct a thorough search to ensure that the literature sources used are truly relevant to the research topic and a comparative analysis approach is used. Comparative analysis is the process of comparing and evaluating the performance of a system with similar existing systems to identify differences, similarities, or relative advantages between the systems (Prasetya, 2017).

RESULT AND DISCUSSION

From a territorial point of view, national airspace is defined as a projection of a country's surface area, both land and water. From an air defense point of view, state airspace is defined as the space over land and/or water areas that are an important part of a country's territory or ADIZ (Air Defense Identification Zone) (Kusumaningrum & Putra, 2019). Operations to maintain the security of Indonesia's airspace can be considered in terms of threats, which are becoming increasingly complex as the strategic environment changes.

Airspace violation or air intrusion is a major threat to Indonesia's airspace today. According to Savitri & Prabandari (2020), air intrusion is when foreign aircraft, both military and civilian, enter the country's airspace without permission. Conditions of air intrusion still occur frequently, such as illegal flights with a specific purpose and accidental or stray flights. This is a real threat that can occur at any time from outside that can threaten the security of Indonesian airspace. Meanwhile, unreal threats in the form of conventional war in Indonesian territory have the opportunity to occur when there is a trigger for open conflict between countries. In order to maintain Indonesia's sovereignty, it is necessary to respond to one of them by strengthening the air defense system.

The ability of a country is very important in dealing with various threats that have been and will be faced, one of which is through the use of air power. The ability of air power to respond quickly, to move freely in the sky, equipped with accurate navigation systems and reliable weapons, is the main value of air power itself. The ability to counterattack quickly, change the target to be attacked, and be able to monitor the opponent's activities through intelligence, surveillance, and reconnaissance capabilities are other important considerations that support air power (Mansur, 2014). For all countries, including Indonesia, air power plays a very important role because it has superior characteristics such as speed, infiltration, and surprise attacks, which become the basis of reference for attacking the enemy's center of gravity. In Indonesia itself, there is an increasing potential threat of espionage in its territorial area. This is due to the fact that some of Indonesia's airspace is controlled by other countries.

Indonesia also does not yet have an independent air defense industry, such as an air power industry network that combines the interests of producers (industry), users (the Indonesian National Army), and the government for national interests. In addition, the development of air power science in Indonesia, both civilian and military, is still minimal. Thus, the development of air power science in Indonesia is still very much dependent on foreign adoption. However, this is not necessarily in accordance with Indonesia's national needs and interests (Prasetyo, 2021).

It is recognized that the development of advanced weapon technologies will dominate and change the nature of future modern air warfare. Air weapon technologies in modern warfare are hypersonic missiles, fifth and sixth generation fighter aircraft, killer drones, cyber attacks in the air domain, and long-range ballistic missiles. These weapons become an air defense system in attacking the enemy with precision and lethality (Prasetyo, 2021).

Developments in the application of future air weapons doctrine and technology have begun to be developed by developed countries, namely the United Kingdom, the United States, Russia and China. The Royal Air Force (RAF) of the United Kingdom has an air weapon system that is interoperable with the United States Air Force (USAF) of the NATO alliance in conducting joint operations. The development of sixth-generation fighters or unmanned aircraft is supported by the UK's industrial airpower network. Several industrialized countries are also developing multi-layered weapon systems. Indonesia as a user and not a master of air technology requires a larger budget allocation for the acquisition of air defense technology in relation to the development of modern warfare through several aspects such as the application of doctrine, air defense systems, air science and technology that take into account an in-depth view of the threats and strategic environment faced.

This discussion provides solutions as a user to the acquisition of air defense technology through a comparative analysis approach of layered air weapon systems that are already in possession of various countries, such as air defense in cities in the face of modern warfare. A multilayered air defense system is an air defense system consisting of several air defense layers that complement and support one another. This system is designed to strengthen a country's air defense against enemy air attacks. This multi-layered air defense system will increase the power of "active defense". The active defense itself is a technology that has the ability to intercept and destroy missiles and rockets in flight, which was considered impossible at the time (Uzi Rubin & Chong Woo Kim; 2017). The concept of this layered defense system consists of three integrated anti-missile systems that are designed to defend and maintain the sovereignty of a country against long-range, medium-range, and short-range missiles.

This layered air defense system is essential to provide maximum coverage against all possible missile threats in areas vulnerable to such threats. According to (Zych, 2020), the current layered defense system consists of three main defense layers: 1) low tier; 2) mid tier; 3) high tier. The low-tier zone has a range of 4 to 70 km. This zone is designed to intercept short-range rockets and mortars. The mid-tier of a layered defense system is a zone capable of intercepting medium-range missiles and cruise missiles fired from 40 km to 300 km, as well as UAVs and enemy aircraft. Then, the upper-layer zone has the capability to intercept medium- to long-range ballistic missiles. This zone covers 300 to 2400 km. An illustration of the multi-layered air defense coverage area is shown in Figure 1.

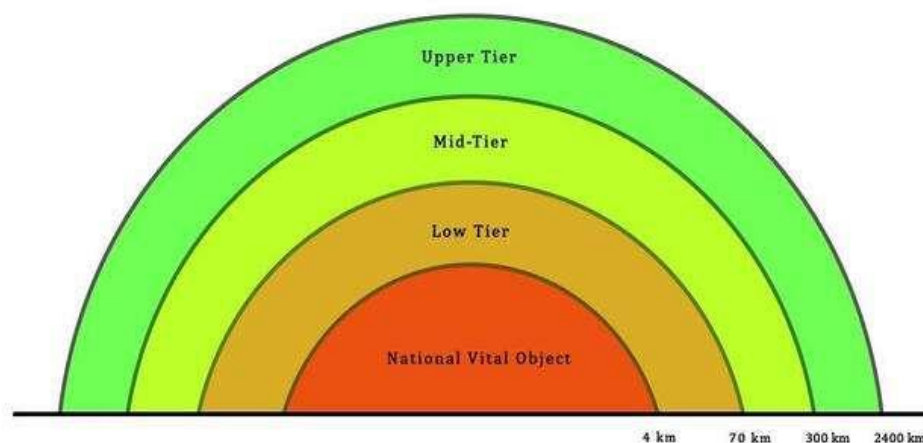


Figure 1. Multi-Layer Air Defense Area
Source: *Team Author, 2023*

Basically, the three elements described by G.E. Lailari, known as Homa, form the basis of the layered defense system, including

- 1) endo-atmospheric interception;
- 2) exo-atmospheric interception;
- 3) interception at the launch phase.

This concept visualizes the creation of a multi-layered missile defense shield under the Air Force. In performing its function, this system must be able to detect enemy threats early and provide early warning to the authorities to take appropriate action (Putri et al., 2022).

The concept of Indonesia's layered air defense system owned by the Indonesian Air Force uses a layered air defense approach consisting of three main sectors, namely point air defense (hanud point), terminal air defense (hanud terminal), and area air defense (hanud area), as shown in Figure 1. Hanud Point is an air defense area located about 18 meters away from national vital objects. In this area, military equipment such as Hanud missiles and Hanud guns are used as a means to destroy potential threats. Terminal Hanud is the second layer of the air defense system and has a range of 18 to 100 km. In this sector, medium-range missiles and fighters are used as defense equipment to deal with threats. Finally, the Hanud sector is the third layer, with a range of more than 100 kilometers. In this sector, the main tools used are strike fighters to deal with threats and military radars for wide-area surveillance (Herzegovina et al., 2021). The following Figure 2 shows the air defense operational area of the Indonesian Air Force.



Figure 2. Air Defense Operation Area
Source: Mabes TNI AU, 2003

There are several layered air weapon systems from various countries, one of which is known as the National Advanced Surface to Air Missile System (NASAMS). This system is an integration of missiles, radars, and command centers that act as a means to detect and destroy air targets. The National Advanced Surface to Air Missile System (NASAMS) is a close-in air defense system developed by Kongsberg Defence & Aerospace and Raytheon, Norway. The system is designed to protect the airspace from enemy air attacks. NASAMS has the ability to detect and track air targets at close range and fire missiles to destroy the targets, as shown in Figure 3. The military can use NASAMS to identify, engage and destroy sixth-generation fighter aircraft, helicopters, hypersonic missiles and UAVs. The system is designed to protect valuable assets and population centers from air-to-ground threats. NASAMS has three main components: AN/MPQ-64 Sentinel radar, Advanced Medium Range Air-to-Air Missile (AMRAAM), and Fire Distribution Center (FDC) (Feickert, 2022).

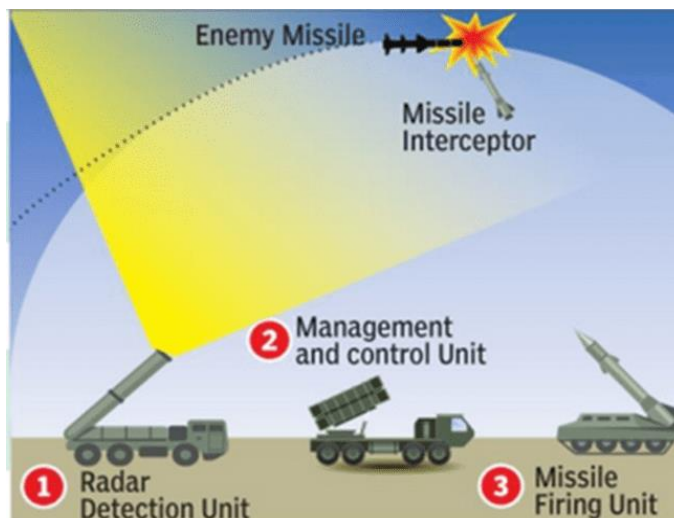


Figure 3. Layered Air Defense NASAMS

The Sentinel radar is capable of detecting UAVs, cruise missiles and fixed- and rotary-wing aircraft, according to the U.S. Army. It has an X-band, 360-degree phased array air defense radar with a target identification range of 75 kilometers (approximately 47 miles). The Sentinel has two ECCM subsystems - an IFF subsystem for positive identification of friendly aircraft and a non-cooperative target detection subsystem for identification of hostile aircraft. The Sentinel is mounted on a trailer and pulled by either a High Mobility Multipurpose Wheeled Vehicle (HMMWV) or a truck from the M1082 family of medium tactical vehicles(Feickert, 2022).

According to Raytheon, the AMRAAM is a dual-role missile that offers operational flexibility in air-to-air and surface-launch engagements. The advanced active guidance sensor and seeker of AMRAAM is said to be able to acquire targets quickly in difficult environments. In the surface-launch mode, NASAMS permits countries to use the same missile in either role with no modifications. The AMRAAMs used by NASAMS reportedly have a range of 40 kilometers (about 25 miles), and longer-range missiles are under development(Feickert, 2022).

In the next discussion, the layered air defense system of the Turkish developer Aselsan is reviewed. Figure 4 shows Turkish developer Aselsan's layered air defense presented at Overseas Field Study, Faculty of Science and Technology, RIDU. Aselsan's layered air defense system has two air weapon subsystems with different specifications. These specs relate to range and type of threat or objective.



Figure 4. Layered Air Defense Aselsan

Source: Team Author from Overseas Field Study, Faculty of Defense Sciences and Technology, RIDU, 2023

The layered air defense in the outer layer subsystem, Hisar-O, consists of a mobile search radar (MAR), namely Hisar O radar Kalkan - II 3D search and track radar, electro-optical system, fire control center, 3 HISAR-O+ missile launchers with a missile range of 25 km, 15 km altitude. This integrated system is capable of simultaneously deterring and destroying up to nine different targets such as sixth-generation fighter aircraft, helicopters, and surface-to-air missiles. The inner-layer subsystems are the Hisar A and Korkut air defense gun systems. Hisar A is installed on trucks and tank platforms and consists of a 3D search radar, an EO sensor suit, and a missile. The missile has a range of 15 km at an altitude of 10 km and can destroy targets such as short-range missiles and guided bombs. Meanwhile, the Korkut Air Defense Gun System itself consists of the Korkut Command Post and the Korkut Gun System. Korkut Command Post consists of a 3D search radar, EO sensor suit, command, and control. Korkut Gun System consists of fire control radar, EO sensor suit, and stabilized gun turret with high firepower at 1100 rpm, 35 mm programmable airbus ammunition, firing on the move capability, high precision gun cueing, and automatic linkless feed mechanism. With these capabilities, it can counter and destroy attacks such as UAVs or loitering ammunition and mortars.

Israel's Iron Dome is another layered air defense system known today. Iron Dome is an all-weather mobile air defense system developed by Rafael Advanced Defense Systems and Israel Aerospace Industries (Zych, 2020). The system is designed to intercept and destroy short-range rockets and artillery shells fired from a distance of 4 km (2.5 miles) to 70 km (43 miles) and whose trajectory would take them into populated areas. The system was designed to counter the rocket threat to civilians on Israel's northern and southern borders using Rafael's Spyder system. Illustration of the Iron Dome layered air defense system in Figure 5.



Figure 5. Iron Dome

In the realm of analyzing layered weapon systems, such as Hisar O, Hisar A, Korkut Gun System, Iron Dome, and NASAMS, it becomes imperative to delve into the comparative analysis and interpret the implications of their similarities and differences. This analysis enables us to gain a comprehensive understanding of these systems and their significance in the Indonesian context.

Let's begin by exploring the comparative analysis of the aforementioned systems. Hisar O, a sophisticated air defense system, showcases advanced capabilities designed to counter aerial threats. Its cutting-edge technology and robust infrastructure provide a formidable defense mechanism. On the other hand, Hisar A, another component of the layered defense, excels in short-range air defense, ensuring effective protection against low-altitude aerial targets.

Moving on to the Korkut Gun System, it presents a unique blend of artillery and air defense capabilities. Its adaptable nature allows it to provide ground forces with enhanced

protection against a wide range of threats. This system's versatility makes it a valuable asset in safeguarding strategic locations and military operations.

In contrast, the Iron Dome system has gained international recognition for its exceptional performance in countering short-range rocket threats. This innovative system incorporates advanced tracking and interception technologies, enabling it to neutralize incoming projectiles with a high success rate. Its proven track record has made it an indispensable asset for nations facing constant rocket threats.

Lastly, the NASAMS (National Advanced Surface-to-Air Missile System) stands out as a versatile air defense solution. Its state-of-the-art radar and missile technologies ensure reliable protection against a variety of airborne threats, including aircraft, helicopters, and unmanned aerial vehicles (UAVs). The NASAMS system provides a comprehensive air defense umbrella, capable of safeguarding critical assets and infrastructure.

Now, let's delve into the implications of these comparative analyses for Indonesia. By understanding the strengths and weaknesses of each system, Indonesian defense strategists can make informed decisions regarding their defense capabilities. This analysis assists in identifying potential gaps in the country's air defense network and formulating strategies to address them effectively.

Additionally, a comprehensive analysis allows Indonesia to assess the compatibility of these systems with its existing infrastructure and operational requirements. Understanding the similarities and differences between these systems helps in selecting the most suitable options for bolstering the nation's air defense capabilities. By capitalizing on the strengths of these systems and integrating them seamlessly into existing defense frameworks, Indonesia can enhance its overall defense posture. A comparative analysis of the layered weapons system is presented in the form of Table 1.

Table 1. Multi-Layered Air Weapon System

Air Weapon System	Weapon Type	Country of User	Distance operations	Radar dan Sensor	Threat Type	Advantages	Disadvantages
Layered Air Defense ASELSAN	Hisar O, Hisar A, Korkut Gun System	Turkey	25 Km	Mobile search radar (MAR) Hisar O radar KALKAN-II 3D search and track radar	UAV or loitering munition, guided bomb, Air to Surface Missile, Fighter aircraft, Short-range missile, mortar.	It is portable and easy to install on various vehicles.	Limited operational range.
Iron Dome	Tamir Interceptor Missile	Israel	Up to 70 km	MMR Radar (Multi-Mission Radar) and Automatic Tracking System	Short – range and medium – range missile, mortar, UAV with a range up to 10 km.	Adaptive ability to cope with varied threats.	High production and operating costs.
NASAMS	AIM-120 AMRAAM (Advanced Medium-Range Air-to-Air Missile)	Norwegian	More than 25 km	AN/MPQ-64 Sentinel	Fighter aircraft, helicopter, medium – range missile and UAV.	Used by several countries, demonstrating international trust.	It is not effective in dealing with rapid air threats.

Source: Team Author, 2023

CONCLUSION

In conclusion, through a comparative analysis of layered weapon systems such as Hisar O, Hisar A, Korkut Gun System, Iron Dome, and NASAMS, we gain valuable insights into their capabilities and implications. Evaluating differences and similarities, can help Indonesian defense planners make informed decisions to strengthen city air defense systems in the modern warfare.

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