

# DEGREE OF SUPERIORITY IN AIR OPERATIONS THEORETICAL ANALYSIS, DETERMINING FACTORS, AND STRATEGIC CASE STUDY

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**Abstrak** — This study aims to analyze the degree of air superiority, a strategic concept that plays a central role in the planning and implementation of modern air operations. This term refers to the degree of control of an air force over a specific area that allows the execution of missions without significant interference from opposing air forces. In general, the degree of air superiority is classified into three categories: air parity, air superiority, and air supremacy, each of which indicates a different degree of dominance over potential enemy air threats. Air dominance is a strategic prerequisite that determines the outcome of modern conflicts. The concept of degree of superiority evolves along with changes in technology, doctrine, and the complexity of global geopolitics. In the context of air operations, achieving degree of air superiority is influenced by various factors, including technological capabilities, the effectiveness of air defense systems, information mastery, and the efficiency of command, control, communications, computers, intelligence, reconnaissance, and surveillance (C4ISR) systems. The interaction of these factors contributes to the success of joint operations and the ability to maintain long-term air dominance. Effective air superiority also directly impacts the freedom of action of one's own forces in conducting cross-service operations. A comprehensive understanding of the degree of air superiority is a key factor in strategic decision-making at the operational level. Integration of technological capabilities, information superiority, and cross-service coordination is necessary to achieve sustainable air dominance. Therefore, analyzing the degree of air superiority is not only crucial for tactical purposes but also serves as the basis for developing comprehensive air defense doctrine and strategy. This article discusses the theoretical framework in depth, the factors influencing its achievement, and presents case studies from various conflicts ranging from World War II to potential conflicts in the Indo-Pacific. This study confirms that successfully achieving air superiority depends not only on air power alone, but also on multi-domain integration, defense industry readiness, and political and diplomatic support.

**Keywords:** Air Superiority, Air Operations, Air Dominance, Military Strategy, Air Defense.

## 1. INTRODUCTION

Air superiority is a key factor in the success of modern military operations. With technological advancements and the complexity of the strategic environment,

control of airspace has become a crucial element in ensuring freedom of action and the effectiveness of cross-service operations. In this context, the degree of air superiority is not only interpreted as superiority in the number or strength of

fighter aircraft, but also as an indicator of a country's or military's ability to control, defend, and optimize airspace to support national strategic objectives. The history of various conflicts demonstrates that the party capable of achieving and maintaining air superiority has a greater chance of winning battles on land and at sea. Air dominance enables the conduct of offensive and defensive operations with minimal interference from opposing air forces, providing advantages in reconnaissance, precision strikes, and logistical mobility. Therefore, understanding the concept of the degree of air superiority has important implications for developing defense strategies and policies. However, achieving air superiority faces increasing challenges with the emergence of anti-access and area denial (A2/AD) technology, layered air defense systems, and cyber warfare that can disrupt command and control systems. This situation demands an adaptive and integrative approach to air operations planning, where technology, human resources, and cross-agency coordination are key factors for success. Therefore, this study aims to comprehensively examine the degree of air superiority as a basis for understanding how air superiority can be achieved and maintained in modern operational scenarios.

## 2. RESEARCH METHODS

This research uses a descriptive qualitative approach with library research on relevant secondary sources. The purpose of this study is to analyze the relationship between the level of air superiority and the effectiveness of joint air operations. Data was obtained through a library study of modern military literature, including scientific journal articles, military agency reports, international organization documents, air defense doctrine, operational analyses and reports from various contemporary conflicts, as well as official guidance regarding

degrees of superiority in air operations. The analysis process was conducted through three main stages: (1) identifying key concepts and variables related to degrees of air superiority; (2) comparative analysis of the application of air superiority in several cases of air operations; and (3) drawing conclusions regarding key factors determining the success of air superiority. Research steps:

- Identify keywords: air superiority, air operations, air dominance, military strategy, air defense.
- Select sources based on relevance to degrees of superiority in air operations.
- Thematic categorization of findings into: degree of superiority in doctrine development, operational planning, and limitations.
- Content analysis to compile a narrative synthesis regarding the influence of air operations on degree of superiority in multi-dimensional domains.

Data validity was strengthened through source triangulation and contextual analysis to ensure the relevance of theory to operational practice in the field. The results of this method are expected to provide a conceptual foundation for the development of air operations strategies and doctrines that are adaptive to modern threat dynamics. A qualitative approach was deemed most appropriate because it can comprehensively illustrate the interrelationships between strategic, tactical, and technological factors in achieving air superiority. Limitations of this research include reliance on open sources that may not cover all classified air operations, and the lack of direct quantitative data on degree of superiority in air operations.

### 2.1. Konsep Air Superiority.

Air superiority is generally defined as a condition in which one side possesses sufficient air control to conduct air operations without significant interference from opposing air forces (Joint Publication 3-30, 2019). This concept evolved from the early

doctrine of air power, first proposed by Giulio Douhet in the early 20th century, which stated that control of the air was a prerequisite for victory in modern warfare. Over time, air superiority has been classified into several degrees or levels: airparity, airsuperiority, and airsupremacy.

- Airparity describes a state of equilibrium in which both sides possess relatively equal air capabilities, resulting in no clear dominance.
- Airsuperiority indicates a level of dominance in which one side is able to conduct operations with limited interference from the enemy.
- Airsupremacy is the highest form of air control, where the opposing side is no longer able to offer effective resistance in the air.

This difference in degree has direct implications for military strategy, operational planning, and the effectiveness of the use of air resources in achieving national strategic objectives.

## **2.2. Factors Determining Air Control**

According to Meilinger (2007) and Lambeth (2018), air control is not solely determined by the number or quality of fighter aircraft, but also by the complex interaction between technological factors, intelligence, and command and control systems. Superiority in Command, Control, Communication, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) capabilities is a key differentiating factor in the ability to control modern airspace. Furthermore, integration with integrated air defense systems (IADS) also influences the degree of air superiority that can be achieved. Other influential factors include:

- Technological superiority and innovation in weapons systems, such as fifth-generation fighter aircraft, precision missiles, and electronic warfare systems.
- Information dominance and situational awareness, which determine the speed and accuracy of decision-making in air

combat.

- Logistics capacity and maintenance support, which ensure the long-term sustainability of air operations.
- Synergy between the air, land, and naval forces, to create a combined effect in military campaigns.

## **2.3. Air Superiority in Joint Operations**

In joint operations, air superiority does not stand alone but is an integral part of cross-service strategy. Air power serves to provide a buffer and protection effect for forces on both land and sea, as well as to strengthen strategic advantage in combat. According to NATO doctrine (AJP 3.3, 2022), adequate air control enables precision strike operations, deters enemy counterattacks, and controls logistics areas and vital communication lines. The concept of joint operations also emphasizes the integration of Unmanned Aerial Systems (UAS) capabilities, cyber defense systems, and space-based assets as a means to maintain sustained air superiority. In the context of modern warfare, which increasingly relies on information networks, the ability to control the electromagnetic spectrum becomes a new dimension in achieving air superiority.

## **2.4. Strategic Relevance in the Modern Era**

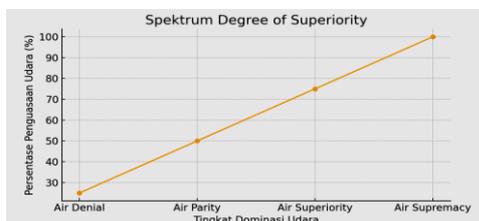
Global security dynamics indicate that the competition for air superiority has now expanded into multi-dimensional domains, including space and cyberspace. Major powers are developing the concept of multi-domain operations (MDO), which integrates all military forces across land, sea, air, cyber, and space to achieve synergistic effects against adversaries (U.S. Army TRADOC, 2022). In this context, the degree of air superiority is no longer solely determined by success in conventional air combat, but also by the ability to maintain networked systems, integrate data across domains, and adapt to non-kinetic threats such as cyberattacks and electronic interference. Examining these aspects is crucial for formulating a national air defense

strategy that is resilient, flexible, and ready to face future challenges.

### 3. RESEARCH RESULTS AND DISCUSSION

#### 3.1. Spectrum of Degrees of Superiority

The spectrum of degrees of air superiority describes the increasing level of air control from airdenial to complete dominance (airsupremacy). In various modern conflicts, variations in the degree of dominance have proven crucial in determining the effectiveness of joint operations and the ultimate outcome of military campaigns.



Grafik: Spektrum Degree of Superiority

The spectrum of air superiority can generally be depicted in four levels: airdenial, airparity, airsuperiority, and airsupremacy. On the left side, airdenial reflects a situation where both sides inhibit each other, preventing either side from effectively exploiting airspace. While the right side (airsupremacy) depicts complete dominance, effectively preventing the opponent from mounting any meaningful air resistance.

#### 3.2. The Spectrum of Degrees of Superiority in Air Operations

In the context of air operations, moving from one level to the next is typically achieved through a combination of counter-air campaigns, destruction of the opponent's air defense systems, and control of the electromagnetic spectrum. This spectrum then serves as an analytical framework for assessing the degree of freedom of action an air force possesses in supporting land and sea operations. The following table summarizes some major conflicts and illustrates the degrees of air superiority and their determining factors in key phases of the campaign:

Fase	Konteks	Periode Waktu / Konflik	Tingkat Keunggulan	Faktor Penentu
	Basic of Degree	Keunggulan "Kor" vs Luftwaffe	Keunggulan "Kor"	Keunggulan "Kor" terhadap "Luftwaffe" dalam hal kemampuan manuver, daya tahan, dan kemampuan menembak.
Perang Korea	1950-1953	Perang Korea 1950-1953 dan PERUSAHA	Air Superiority	Keunggulan "Kor" dalam hal kemampuan manuver, daya tahan, dan kemampuan menembak.
Perang Teluk 1991	Operasi Badr dan Desert Storm	Operasi Badr dan Desert Storm	Keunggulan "Kor" dalam hal kemampuan manuver, daya tahan, dan kemampuan menembak.	
Perang Kosovo 1999	NATO vs Yugoslavia	NATO vs Yugoslavia	Keunggulan "Kor" dalam hal kemampuan manuver, daya tahan, dan kemampuan menembak.	
Perang Libanon 2006	ISRAEL vs Hizbullah	ISRAEL vs Hizbullah	Keunggulan "Kor" dalam hal kemampuan manuver, daya tahan, dan kemampuan menembak.	

#### 3.3. Discussion

In the Battle of Britain, the British successfully moved from a serious threat to a defensive air superiority state thanks to a combination of radar systems, command networks, and operations focused on protecting their own territory, thus frustrating the Luftwaffe's attempt to achieve strategic air dominance. This conflict demonstrated that even without absolute numerical superiority, the integration of sensors, command, and defensive tactics can shift the spectrum from potential air denial to a level of functional dominance sufficient to thwart an opponent's strategic objectives. The Korean War and the Gulf War demonstrated the importance of technological and logistical superiority in consolidating air superiority into relatively stable dominance. In Korea, the emergence of MiG-15 jets briefly created a local zone of parity, but a rapid response with F-86s and C4ISR support restored UN air superiority. In the Gulf, the coalition's SEAD/DEAD campaign destroyed Iraqi IADS, shifting the spectrum rapidly toward air supremacy, enabling widespread offensive air operations at low risk to attacking aircraft. The Kosovo War confirmed that air supremacy can be achieved at the operational level without a significant ground presence. However, the threat of lingering, albeit limited, SAM systems still forces adjustments in tactics and altitude. This demonstrates that at the local tactical level, the spectrum can fluctuate between air superiority and a limited form of air denial created by the threat of stealthy and mobile surface-to-air missiles.

### 3.4. Analysis Results

The contemporary Ukrainian conflict demonstrates that the density of modern air defense systems, including long-and medium-range SAMs, and the proliferation of UAVs, can keep both sides in the spectrum zone between air denial and air parity for extended periods. This limits the ability of both sides to conduct large-scale offensive air campaigns like those seen in the Gulf War and forces a shift to the use of long-range missiles, kamikaze drones, and stand-off strikes as alternatives to traditional air attacks. Across the five case studies, the spectrum analysis of degrees of air superiority indicates that:

- Successfully achieving full air supremacy only occurs when one side is able to systematically damage or neutralize the opponent's IADS and master C4ISR.
- In a layered and adaptive air defense environment, such as in Ukraine, the spectrum structure tends to be "locked" between air denial and parity, making absolute air dominance extremely difficult to achieve.
- Consistent determinants across conflicts are technological integration (sensors, precision weapons, EW), the quality and experience of aircrews, logistical strength, and joint command and control capabilities capable of synergizing across operational domains.

These findings confirm that air superiority is not simply the result of superior air platforms, but rather the outcome of an integrated, adaptive military system capable of combining forces across multiple domains to shape favorable spectrum conditions throughout an operational campaign.

#### 3.4.1. Implications

The implications of the degree of air superiority for doctrine, capability development, and conceptual recommendations are closely related to how air power is designed, operated, and assessed within the framework of modern joint operations. The spectrum of air denial, parity, superiority, and supremacy is treated as an operational

variable that directly guides tactical, operational, and strategic decisions.

#### 3.4.2. Doctrinal Implications

Doctrinally, the degree of air superiority is viewed as a condition that enables or constrains the freedom of action of joint forces and therefore must be an explicit intermediate objective in air and joint campaigns. Modern Indonesian Air Force doctrine places control of the air as one of the primary lines of operation, with an emphasis on integrating offensive and defensive (counter-air) operations to shift the spectrum from parity to superiority and, where possible, supremacy. The following table summarizes the key doctrinal implications of each degree of air superiority:

Tingkat degree of air superiority	Implikasi doktrinal utama	Penekanan konsep operasi
Air denial / unfavourable air situation <a href="#">uni-nke</a>	Operasi udara ofensif sangat terbatas: prioritas kekuatan sendiri dan pelestarian aset; manuver darat-laut lebih mengandalkan kamufase, dispersi, dan perlindungan pasif.	Fokus pada defensive counter-air (DCA), dispersal, passive air defence, operasi terbatas, serangan stand-off dalam skala kecil. <a href="#">cenjows+1</a>
Air parity <a href="#">canada+1</a>	Kedua pihak saling menghambat, operasi joint tetap mungkin namun bensiko tinggi dan sangat bergantung pada jendela waktu dan koridor aman.	Kombinasi offensive dan defensive counter-air, upaya SEAD/DEAD bertahap, operasi udara ofensif selektif dan terbatas di sektor prioritas. <a href="#">airuniversity.af+1</a>
Air superiority <a href="#">canada</a>	Kebebasan bertindak meningkat untuk operasi darat dan laut; memungkinkan <i>deliberate</i>	Kampanye SEAD/DEAD berkelanjutan, serangan interdiksi dan deep strike; dukungan udara dekat intens, eksploitasi ISR dan C4ISR
Tingkat degree of air superiority	Implikasi doktrinal utama	Penekanan konsep operasi
	<i>targeting</i> , operasi serangan presisi, dan dukungan udara dekat yang lebih konsisten.	untuk mempertahankan dominasi. <a href="#">airuniversity.af+1</a>
Air supremacy <a href="#">canada+1</a>	Lawan praktis tidak mampu mengganggu operasi udara; memungkinkan kampanye udara ofensif luas dan tempo operasi joint sangat tinggi.	Penekanan pada eksploitasi efek udara (strike, interdiksi, strategic attack) dan perlindungan domain lain, dengan operasi counter-air lebih bersifat <i>maintenance</i> atas dominasi yang ada. <a href="#">airuniversity.af+1</a>

Another important implication is that the higher the degree of air superiority, the greater the ability to implement more stringent targeting procedures, such as more comprehensive collateral damage estimation, due to the reduced threat pressure on air platforms. This positions air superiority not only as a military factor but also as an enabler for better fulfillment of international humanitarian law obligations in air strike practices.

#### 3.4.3. Analysis of the Doctrinal Implications of Degrees of Superiority

Doctrinally, the air-denial-parity-superiority-

supremacy spectrum serves as a frame work that defines the air conditions that must be achieved to enable or protect joint operations. Each level is not simply a label, but an operational target that determines priorities: in air denial, the focus is on defending and hindering the opponent, while in air superiority/supremacy, the focus shifts to exploiting the air to support strategic strikes, interdiction, and close air support. Implications:

- Doctrine needs to tie the degree of superiority objective to the campaign phase. For example, the initial phase should be directed at reducing the enemy's air threat (SEAD/DEAD) to shift the spectrum from denial/party to superiority in critical sectors.
- Joint decision-making—for example, opening logistics air corridors, engaging near-forward air forces, or executing deep strategic strikes—must explicitly reference the current assessment of the level of air control in each sector.

In the highly contested modern threat environment, doctrine must also recognize that permanent air supremacy is often unrealistic; a more practical goal is to create a window of localized air superiority sufficient to provide a specific operational effect. Thus, degree of superiority becomes a dynamic variable to be managed, rather than a static end state assumed throughout the campaign.

### 3.4.4. Capability Development

Capability development (force development) should be directed at enabling a shift in the air control spectrum to a more favorable level through a combination of platforms, networks, and defense systems. Future planning documents such as the *Air Superiority 2030 Flight Plan* and various contested battlespace analyses emphasize networked C4ISR capabilities, manned-unmanned platforms, and advanced SEAD/DEAD systems as key to future air dominance. The following table summarizes the capability development elements

associated with each degree of air superiority:

Aspek kemampuan	Kebutuhan minimum untuk keluar dari denial/party	Kebutuhan untuk mempertahankan air superiority	Kebutuhan mendekati supremacy	untuk air
Platform tempur & sensor airuniversity.af+1	Pesawat tempur generasi 4/4.5 dengan radar dasar, radar konvensional beberapa platform ISR terbatas.	Kombinasi pesawat generasi lanjut, AWACS/AEW&C, tanker, platform ISR udara ruang angkasa, kemampuan EW bawaan.	Platform stealth/low observable, sensor fusion tingkat tinggi, kombinasi fighter berawak dan collaborative combat aircraft (CCA) tak berawak radr-1	
SEAD/DEAD & EW japcc+1	Kemampuan SEAD dasar (anti-radar missile, jamming terbatas) untuk membuka koridor sempit.	Paket SEAD/DEAD terintegrasi dengan EW ofensif, kemampuan targeting mobile SAM.	SEAD/DEAD berkelekaan terhadap IADS bertapis, integrasi siber-EW untuk melumpuhkan jaringan komando pertahanan udara lawan.lapcc-1	
C4ISR & jaringan data theairpowerjournal+1	Jaringan komando dan kontrol dasar dengan beberapa data link tak sepenuhnya real-time.	Arsitektur joint common operational picture, data link aman, integrasi ISR multi-domain.	C4ISR multi-domain berketahanan tinggi, pemanfaatan ruang proses untuk decision support real-time.theairpowerjournal+1	
Tingkat degree of air superiority	Implikasi doktrinal utama	Penekanan konsep operasi		
	targeting, operasi serangan presisi, dan dukungan udara dekat yang lebih konsisten.	untuk mempertahankan dominasi.airuniversity.af+1		
Air supremacy canada+1	Lawan praktis tidak mampu mengganggu operasi udara, memungkinkan kampanye udara ofensif luas dan tempo operasi joint sangat tinggi.	Penekanan pada eksploitasi efek udara (strike, interdiksi, strategic attack) dan perlindungan domain lain, dengan operasi counter-air lebih bersifat maintenance atas dominasi yang ada.airuniversity.af+1		

The development of these capabilities needs to be directed to face an increasingly contested threat environment, where permanent air supremacy is almost unrealistic and what is more feasible is temporary and local air superiority to open a window of maneuver for joint forces. Table Comparison of Air Superiority and Air Denial Concepts. The following table highlights the conceptual differences and their implications in joint operations between air superiority and air denial:

Aspek	Air superiority	Air denial
Definisi dasar wikipedia+1	Tingkat penguasaan udara di mana satu pihak dapat melaksanakan operasi udara dengan gangguan terbatas dari lawan.	Kondisi di mana satu pihak berupaya mencegah lawan menggunakan ruang udara secara efektif, tanpa harus menguasai udara sendiri.
Tujuan airuniversity.af+1	utama Memproduksi kebebasan bertindak maksimum bagi operasi darat, laut, dan udara sendiri.	Mengurangi atau meniadakan efektivitas operasi udara lawan, sering kali meski dengan
Aspek	Air superiority	Air denial
Fokus operasi	Offensive dan defensive counter-air, SEAD/DEAD, pengawasan dan perlindungan, eksploitasi ISR untuk dominasi.airuniversity.af+1	kebebasan bertindak sendiri yang terbatas. Pertahanan udara bertapis, penyebaran (dispersal), kamufase, penggunaan SAM/AAUAV untuk mengganggu dan mengerahkan biaya tinggi lawan.cenjows+1
Dampak pada joint ops canada+1	Memungkinkan operasi daralautan manuver luas, dukungan udara dekat, interdiksi dalam, dan operasi logistik udara yang relatif aman.	Operasi darat/lautan harus dirancang dengan asumsi ancaman udara signifikan; manuver dibatasi, penekanan pada perlindungan pasif dan taktik menghindar.
Struktur kekuatan dominan rdsi+1	Kombinasi fighter generasi lanjut, AWACS, tanker, ISR, EW, dan sistem SEAD/DEAD.	IADS kuat (SAM, radar), point defence, counter-IADS, jarak jauh, platform udara ofensif bisa terbatas.
Konteks tipikal instituteofgeoeconomics+1	Koalisi kuat pada Perang Teluk 1991 dan NATO di Kosovo mencapai air superiority/supremacy terhadap lawan yang IADS-nya dilumpuhkan.	Lingkungan seperti Ukraina kontemporer, di mana kedua pihak menggunakan AD kuat sehingga tidak ada pihak yang mendapatkan dominasi penuh.

This comparison confirms that air superiority is oriented toward offensive freedom of action, while air denial is relatively more defensive and oriented toward limiting the opponent, although both can be rational choices depending on strategic strengths and objectives.

### 3.4.5. Degree of Superiority Effectiveness Evaluation Metrics

To assess the effectiveness of degree of superiority achieved in air operations, metrics that combine quantitative and qualitative indicators are needed. Some common categories of metrics proposed in airpower doctrine and studies include:

- Outcome-based metrics.
  - The ratio of effective sorties vs. sorties disrupted or aborted due to enemy air threats.
  - The rate of aircraft and UAV losses relative to the intensity of operations, as an indicator of residual risk in the air.
  - Degradation of enemy air capabilities (number of remaining aircraft, enemy sorties per day, or drastically reduced enemy AD use).
  
- Freedom of maneuver and access metrics.
  - The percentage of airspace or corridors routinely usable for various mission types (strike, ISR, transport, CAS) at an acceptable level of risk.
  - Availability of low-threat time windows to support specific joint operations, such as landing operations or major ground assaults.
  
- Metrics of adversary IADS degradation and SEAD/DEAD effectiveness.
  - The success rate of land/sea missions explicitly dependent on air support and/or specific conditions of degree of superiority (e.g., success of air logistics corridors, number of CAS missions conducted per day).
  - Reduction of the threat to ships, land convoys, or other centers of gravity

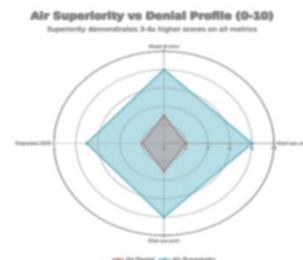
of adversary air attacks in zones where air superiority is claimed. The following summary table relates metrics to operational objectives:

Kategori metrik	Contoh metrik praktis	Indikasi terhadap degree of superiority
Hasil operasi udara airuniversity.af+1	Rasio sortie berhasil, rasio kerugian pesawat/UAV, sortie lawan per hari.	Semakin tinggi keberhasilan dan semakin rendah kerugian serta aktivitas lawan, semakin mendekati superiority/supremacy.
Akses & manuver canada+1	Persentase ruang udara aman, jumlah jendela waktu aman per hari.	Mencerminkan kebebasan bertindak, jika akses luas dan berkelanjutan, spektrum bergeser keluar dari denial/party.

Kategori metrik	Contoh metrik praktis	Indikasi terhadap degree of superiority
Degradasi IADS lawan japcc+1	Radarr/SAM/CC AD yang dinetralkan, pola tembakan SAM, aktivitas EW lawan.	Semakin terdegradasi IADS lawan, semakin berkelanjutan dan luas tingkat air superiority yang dapat diklaim.
Efek pada joint ops ifri+1	Keberhasilan operasi darat/laut yang bergantung pada dukungan udara, penurunan serangan udara lawan pada unit sendiri.	Menunjukkan sejauh mana degree of superiority benar-benar dikonversi menjadi keuntungan operasional lintas matra.

By using these metrics in a structured manner, the Joint Air Command staff can assess whether claims of air superiority in a sector are truly reflected in reduced threats and increased freedom of operation, or whether they are merely nominal with no substantial effect on campaign outcomes. This approach helps make degree of air superiority a concrete control and evaluation tool, rather than simply an abstract doctrinal term. Degree of air superiority evaluation metrics chart.



The graph uses a radar/spider chart format with four metric axes, namely: Air operation results, Air access & maneuver, Degradation of enemy IADS and Effect on Joint Air Operations

- The graph displays two illustrative profiles:
- Air Denial Condition, with relatively low scores across all axes (e.g., 2–3 on a 0–10 scale), reflects low sortie success, limited access, persistent enemy IADS, and minimal air impact on joint operations.
  - Air Superiority Condition, with high scores across all axes (around 7–8), depicting high sortie success, extensive and sustained air access, significantly

*degraded enemy IADS, and a strong contribution to the success of joint operations.*

*This type of graph can be used as a visual aid in campaign assessments to compare initial and post-counter air or SEAD/DEAD campaigns, as well as to differentiate between different operational sectors within a single theater. The overall discussion demonstrates that the degree of air superiority is a central variable linking doctrine, force structure, the execution of air operations, and the success of joint operations across the service branches. The spectrum of air denial–parity–superiority–supremacy has proven to be more than just theoretical categories, but operational conditions that directly determine the degree of freedom of action, risk profiles, and realistic operational concept choices for command staff at all levels.*

#### **4. CONCLUSIONS AND RECOMMENDATIONS**

##### **4.1 Conclusions**

- First, from a conceptual and historical perspective, case studies of the Battle of Britain, the Korean War, the Gulf War, the Kosovo War, and the Ukrainian War demonstrate that the level of air dominance significantly determines the form and outcome of military campaigns. In the Gulf War and Kosovo, successfully destroying or disabling an opponent's integrated air defense system enabled a rapid shift from air superiority to near-air supremacy, allowing large-scale offensive air operations to be conducted with relatively low risk. In contrast, the Ukrainian War illustrates a contested airspace environment that holds both sides between air denial and air parity, preventing either side from repeating the pattern of air dominance seen in the Gulf War.*
- Second, from a doctrinal perspective, the degree of air superiority needs to be treated as an explicit intermediate objective in every phase of a campaign,*

*not a static assumption. Modern doctrine demands that the air superiority status in each sector (denial, parity, superiority, or supremacy) directly guides target determination, mission priority (especially counter-air and SEAD/DEAD), and decisions about when and where large-scale land and sea operations can be conducted with an acceptable level of risk. Consequently, joint operations planners must always pair land/sea maneuver objectives with measurable air control targets in space and time.*

- Third, from a capability development perspective, air dominance in the modern era is no longer solely a function of the number and quality of fighter aircraft, but rather the result of systemic synergy between manned and unmanned platforms, C4ISR networks, SEAD/DEAD and electronic warfare systems, and layered air defenses. Radar and AWACS, secure data links, multi-domain sensors, and space and cyber integration are the differentiating factors that determine whether an air force can sustainably shift the spectrum from parity to superiority. Conflict experience shows that parties that fail to develop adequate C4ISR networks and counter-IADS capabilities tend to be trapped in prolonged states of air denial or parity.*
- Fourth, the discussion of evaluation metrics demonstrates that the effectiveness of degrees of superiority is only meaningful if it can be measured and linked to tangible results in the theater of operations. Indicators such as the successful sortie ratio, own aircraft loss rate, reduction in enemy air activity, degradation of enemy IADS, extent of safe air access, and the direct effect on the success of land/sea operations provide a more concrete picture of whether claims of air superiority are truly achieved or merely nominal. Graphical visualizations (e.g., radar charts for the four main metric groups) help command*

ders and staff conduct regular assessments and compare conditions between sectors or between campaign phases.

- Fifth, future operational trends characterized by air defense density, the proliferation of UAVs and cruise missiles, and the increasing role of cyber and electronic warfare (EW) indicate that absolute air supremacy will become increasingly rare. More realistic is the achievement of localized and temporary air superiority in a defined space and time to support specific operational objectives. This requires doctrinal flexibility, a command structure capable of managing multi-domain effects, and air power designed to operate in a continuously contested environment.

#### 4.2 Recommendations

- Doctrinal Recommendations.
  - Formalization of the spectrum of degrees of superiority in doctrine. Air and joint operations doctrine should include clear operational definitions for air denial, parity, superiority, and supremacy, complete with indicators and applicable examples at the tactical, operational, and strategic levels. This helps all services share a common language about air conditions and facilitates the development of appropriate rules of engagement and contingency plans.
  - Explicit linkage between land/sea objectives and air control objectives. Each campaign should formulate air control objectives as a prerequisite or enabler for maneuver and offensive operations in other domains. For example, large amphibious landing operations should only be conducted if local air superiority can be maintained for a specified period. This encourages closer synchronization between air and land/sea planners.
  - Emphasis on the concept of localized air superiority. Doctrine needs to recognize that in a high-threat environment, the most practical objective is to create local, temporary windows of air superiority, rather than permanent dominance across the theater. This concept encourages the use of air power in a pulsed pattern to open and close air corridors as needed by joint operations.
- Doctrinal Recommendations.
  - Prioritize C4ISR and joint data networks. Strengthening C4ISR should be a top priority, alongside fighter platform modernization. Without a comprehensive air picture, sensor fusion, and reliable data links, the ability to assess and shift degrees of superiority will be severely limited, regardless of the sophistication of the fighter aircraft.
  - Invest in integrated SEAD/DEAD and EW. Given the key role of IADS in deterring warring parties in Ukraine and other conflicts, integrated SEAD/DEAD capabilities with electronic warfare and cyber warfare must be developed as a key pillar of air power. The goal is not only to destroy platforms but also to disable enemy air defense command and sensor networks, shifting the spectrum to superiority.
  - Development of a multi-domain architecture and layered air defense. Air power must be designed as part of a multi-domain architecture that connects air, land, sea, space, and cyber capabilities. At the same time, national air defenses need to be built in layers to minimize the opportunity for an adversary to achieve air superiority in one's own territory and to enforce an air denial strategy if the balance of power precludes pursuing complete air dominance.

- *Extensive integration of manned and unmanned platforms. The combination of manned aircraft, various classes of UAVs, and collaborative combat aircraft allows for more flexible operations in high-threat environments, with more manageable risks. Unmanned platforms are crucial for ISR, high-risk SEAD, and precision strikes under the umbrella of an adversary's air defense.*
- *Conceptual and Evaluation Recommendations.*
  - *Develop a metrics-based degree of superiority assessment framework. It is recommended to formulate an air superiority assessment framework that incorporates four main groups of metrics: air operations results, access and maneuver, degradation of the adversary's IADS, and effects on joint operations. The use of graphics such as radar charts to illustrate air superiority and air defense profiles facilitates the communication of air conditions to decision-makers.*
  - *Make air superiority assessments a continuous process. Degree of superiority assessments should be conducted periodically and automated to the extent possible, utilizing data from ISR sensors, mission reports, and intelligence on enemy Army activity. Assessment results should be directly integrated into the daily planning process (air tasking cycle) to prioritize missions and manage risks.*
  - *Link degree of superiority to risk management and humanitarian law. The higher the degree of air superiority, the greater the ability to plan attacks with a more rigorous targeting process, including more precise collateral damage estimation and more precise selection of precision munitions. Thus, air*

*superiority serves not only as a military advantage but also as an instrument to enhance compliance with humanitarian law and reduce the impact on non-combatants.*

- *Incorporate coalition and alliance dimensions. In coalition operations, the division of tasks between partner nations—for example, some focusing on air denial and air defense, while others focus on air penetration and SEAD—can have a cumulative effect that shifts the spectrum toward air superiority at the theater level. Therefore, standardization of doctrine and interoperability of command and data link systems need to be a constant part of force development planning.*

*Overall, the degree of air superiority needs to be understood and managed as a core element of operational design.*

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