

LITERATURE REVIEW ON CONVENTIONAL DETERRENCE AND GROUND-BASED AIR DEFENSE

Cel Inf Aer Luís Marcelo Sotoriva¹, Ten Cel Inf Aer Rogério Barbosa Marques², Cap Inf Aer Raphael de Almeida Leitão³; Dr. Murillo de Oliveira Dias;⁴ Cel Inf Pedro Winkelmann Santana de Araújo;⁵ Cel Av R1 Flavio Duarte Machado.⁶

¹ Graduate student in Specialization in Military Sciences, with an emphasis on Politics, Strategy and High Military Administration at School of Command and Staff of the Army, ECEME, Brazil.

E-mail: lmarcelosotoriva@gmail.com/ ID Lattes: 9332291679427840.

² M.Sc. Degree in Electronics and Computing Engineering from the Aeronautic Institute of Technology, ITA, Brazil.

E-mail: marquesppgao@gmail.com / ID Lattes: 7609895497144009

³ Master's Student of the Postgraduate Program in Aerospace Science at Air Force University, PPGCA-UNIFA, Brazil.

E-mail: leitao_raphael@hotmail.com / ID Lattes: 3394500266599753

⁴ Coordinator of DBA Programs at Fundação Getulio Vargas, Brazil.

E-mail: murillo.dias@fgv.br / ID Lattes: 1260045014756267

⁵ Teacher in Specialization in Military Sciences, with an emphasis on Politics, Strategy and High Military Administration at School of Command and Staff of the Army, ECEME, Brazil.

E-mail: celwinkelmann@gmail.com/ ID Lattes: 2526331659759139

⁶ Master's Student of the Postgraduate Program in Aerospace Science at Air Force University, PPGCA-UNIFA, Brazil.

E-mail: flaviorj73@gmail.com.br/ ID Lattes: 3322508501179824

ABSTRACT

For Brazil to adopt a stance aimed at the peaceful resolution of conflicts, the country must deter potential opponents from carrying out hostile acts against the national territory. Through an extensive literature review, this article investigated the epistemological evolution of the relationship between dissuasion and anti-aircraft defense, seeking substantial evidence on how these means of defense can influence the decision-making process of a possible opponent to initiate or not an armed confrontation. The results showed the relevance of dissuasion and anti-aircraft defense in conflict prevention, highlighting the importance of the participation of the country's senior management and aspects related to capacity, credibility, communication, and uncertainty, in order to lead hostile forces to act as unfavorable the cost-benefit ratio of carrying out aggression. The research is helpful to academics and professionals involved in politics, strategy, defense, and researchers in general. Discussion on the subject and recommendations for future studies complement this work.

Keywords: Deterrence. Strategy. Ground-based air defense.

INTRODUCTION: -

Around 400 BCE, the Roman writer Flavius Vegetius Renatus, in the classic *De Re Militari* (the military art, our translation), already stated that "Whoever desires peace prepare the war. [...] No one will dare provoke or offend the one he considers superior in combat." (Vegécio, 1995, p. 72). The Brazilian Federal Constitution 1988, in its Article Four guides the country's posture from the perspective of non-intervention and the peaceful conflict settlement (Brasil, 1988). However, to adopt such a stance, it is necessary that the country is able to deter potential opponents from carrying out hostile acts against the national territory. The ability to generate dissuasion is closely linked to the posture of a country's top leader, as well as to the defense strategy adopted by that nation, which, in turn, depends on means to be implemented (Beaufre, 2016). An estimate made under the coordination of the Ministry of Defense, called Defense Scenarios 2020-2039: Sumario Executivo (Brasil, 2017), indicates that any conventional military actions against Brazil will seek to reach the centers of gravity concentrated in the Southeast, employing, in particular, air, marine and cyber net means. Therefore, it is necessary to have superiority of the spatial, cybernetic, and aerial domains to contain such aggressions. This document is one of the bases for the preparation of the National Defense Policy (PND), which clarifies that the ability of the Armed Forces to control Brazilian airspace and maintain continuous development in the aerospace field is essential to safeguard the sovereignty and promote the necessary dissuasion (Brasil, 2016).

Thus, the introduction of the PND brings to remarkable light characteristics of our country by mentioning that it has a prominent role in the world environment, being the fifth largest in territorial extension, once among the ten most populous countries, and with one of the largest economies on the planet. "Endowed with a wide range of natural resources and technological and industrial potential in an accelerated process of advancement, the country has been obtaining a growing international projection and can be involved in possible conflicts of interest with actors of various natures." (Brasil, 2016, p.7). In essence, it is important to highlight the complexity of establishing efficient territorial defense strategies in a country of continental dimensions that resembles, in extension, countries that have a broad engagement in the use of surface-to-air weapons systems, such as the United States, China, Russia and Iran. Thus, it is essential that Brazil to focus continuous attention to its defense, with systems capable of offering deterrent capacity capable of convincing a possible opponent to change his mind in scenarios of crisis or imminent conflict, given the systematic condition of instability of relationships between countries and the emergence of new threats in the international scenario (Brasil, 2016). The PND establishes as one of the national objectives "the defense capacity, for the fulfillment of the constitutional missions of the Armed Forces", and it is necessary to "provide the Armed Forces with the necessary capabilities to carry out the surveillance, control and defense of the territory, jurisdictional waters and Brazilian airspace and to provide the security of maritime communication lines" (PND, 2016, p.12). In this sense, the Ministry of Defense has carried out actions to develop the armed forces' anti-aircraft defense capability. Three Working Groups were created to deal with logistical and doctrinal aspects related to the acquisition and operation of medium and long-range anti-aircraft defense systems (BRASIL, 2020b, c, d), and the requirements of the medium-range system were approved (BRASIL, 2020a) and the Brazilian Army designated as the Lead Force in conducting the process of obtaining the Medium Height/Medium Range Anti-Aircraft Artillery System (Brasil, 2021).

The present work aimed to investigate the current approaches to desuasion, more specifically about the relationship between dissuasion and anti-aircraft defense, seeking relevant evidence on how these means of defense can influence the decision-making process of a possible opponent to initiate or not a conflict. In the next section, methodological procedures and research limitations are analyzed. In the next section, the research design and limitations are discussed.

RESEARCH DESIGN AND LIMITATIONS: -

The present work is descriptive, retrospective research based on secondary data extracted from extensive comprehensive and systematic bibliographic reviews on the subject. Analysis was limited to aspects of conventional deterrence, focusing on anti-aircraft defense, not considering other aspects, such as the capacity to use nuclear weapons, training, personnel, logistical infrastructure, and C2. Therefore, it was not considered necessary to submit this research regarding the appreciation of the Research Ethics Committee. In the next section, we present the existing approaches on the proposed topic. The case has political, strategic, and military implications and may eventually indirectly involve civil aviation, depending on the strategic and operational scenario found. In the next section, the literature review is presented.

LITERATURE REVIEW ON DISSUASION AND GROUND-BASED AIR DEFENSE: -

The deterrence has been studied in the light of nuclear and conventional strategies under the approach of classical and contemporary theorists of themes, such as: i The Absolute Weapon; Atomic Power and World Order, Brodie, 1996; ii Introduction to strategy, Beaufre, 2016; iii Peace and war between nations, Aron, Bath & Paim, 2018; iv Deterrence, Freedman, 2004; v Conventional Deterrence, Mearsheimer, 1985; vi Bombing to win: air power and coercion in war, Pape, 1996; vii Arms and Influence, Schelling, 2008; viii Deterrence by Denial and Punishment, Snyder, 1959; ix Air warfare, Sherman, 2002, and finally x A short operational history of Ground-Based Air Defense, Werrell, 1998.

DETERRENCE: -

Shortly after the end of World War II, Brodie (1946) realized that in modern times, avoiding wars became the military's primary purpose, even overcoming the task of winning them. In this line, Freedman (2004) asserts that dissuasion is part of international relations. Its main objective is to maintain an international order where military power occurs only if necessary to stop the inappropriate use of force.

However, such an understanding does not mean that nations should give up their military capability, as Schelling (2008) recalls the power to hurt impresses and grants him bargaining capacity, ultimately reducing the need for such power to be used.

Thus, dissuasion aims to maintain the status quo, seeking to persuade an opponent not to initiate specific military action for fear that the perceived benefits from military action do not justify the estimated costs and risks, both non-military and military (MEARSHEIMER, 1985).

Aron (2018) argued that the deterred prefer the situation resulting from inaction to the one that would result from the action due to the fear of the consequences of executing an implicit or explicit threat.

Reinforcing, Freedman (2004) understands that the great challenge of deterration is that it is internalized by the one to whom it is addressed, so that, even without a declared threat, the deterred does not perform an undesirable action, because it visualizes that such an act generates the risk of bringing him consequences which he is not willing to suffer.

Deterrence can be based on both punishment and denial. The first, usually associated with nuclear weapons, use the threat of significant destruction, which affects both the civilian population and the productive capacity

of an opponent. Denial, in turn, seeks to convince an opponent, through the use, usually of conventional weaponry, that their objectives on the battlefield will not be achieved (MEARSHEIMER, 1985; SNYDER, 1959).

Freedman (2004) asserts that persuading the enemy through the threat of punishment seeks to make him realize that his actions can obtain the gains would be quickly overcome by the imposition of intolerable damage. Otherwise, denial seeks to lead to the understanding that gains would be overly difficult to obtain.

Freedman (2004) also states that denial is more reliable than punishment as a means of generating dissuasion. Pape (1996) adds that even states with lower military capabilities that their opponents can dissuade them by threatening to charge a very high price on casualties during clashes, to make them lose confidence in their combat strategy.

DETERRENCE AND STRATEGY: -

Beaufre (2016) emphasizes the link between strategy and dissuasion as decisive for military victory. He states that the purpose of the strategy is to convince the adversary that "engaging or continuing in the fight is useless" (BEAUFRE, 2016, p. 28).

In a related way, this author affirms that he will achieve victory if he can perform his preparatory maneuvers in order to maintain his freedom of action and prevent adverse maneuvers, in order to reach the decisive point of the conflict favorably, that is, "The struggle for freedom of action is, in fact, the essence of the strategy." (BEAUFRE, 2016, p. 151). Thus, the protection of one's freedom of action and the ability to deprive the freedom of action of the opponent is the basis of the strategic game.

Along these lines, Mearsheimer (1985) argues that the choice and confrontation of military strategies by the deterrent and deterred determines the probability of deterrents functioning. The author bases his analyses on strategies of blitzkrieg, war of attrition, and strategy of achieving limited objectives, with emphasis on the view of aspects related to attacking ground forces, in confrontation with the strategies of defense in-line or in-depth, each with variants between maintenance of fixed means on the ground or mobile. Naturally, each strategy interaction has different implications for dissuasion, but it should be noted that the strategies that are most likely to gain for defense are based on mobility. In addition, the author understands that defense in depth is excellent. However, it requires so many means to be implemented that, in general, it can only be used in relatively restricted and valuable areas.

Aron (2018) argues that psychological, technical, and political factors are considered for deterrence to occur. The psychological aspect is related to the opponent's ability to convince the resolution as to the threat, that is, the intention of the deterrent to materialize it. The technical factor depends on the availability by the deterrent of material means, particularly armaments, to meet their threats, including the analysis of the intensity of the damage they are capable of generating. Finally, the political element is based on the judgment of the resulting advantages and disadvantages, for the object of dissuasion, of acting or refraining from action.

Along these lines, Beaufre (2016) stresses that one of the bases of dissuasion is credibility: the opponent must be informed that the means exist and the willing to employ them. This author adds a factor that he considers to be essential to dissuasion: uncertainty. There must be several possibilities for the use of force, and these need to be known to the opponent, seeking to keep alive all the hypotheses that can lead to fear to the opponent. However, it is avoided that it knows how effectively the force will be applied, generating the desired uncertainty.

Also, in line with Aron (2018), Beaufre (2016) points out that it is necessary to have the appropriate means to make a strategy. Thus, the strategist should "guide" the development of new military employment materials so that he can have the war equipment that best meets the needs of the planned strategy. In other words, the strategy should guide the achievement of the means, not the available means to determine the strategy.

Freedman (2004) reinforces the need for those who are threatening to have credibility, which the opponent determines by analyzing how the deterrent has behaved in the past in situations where there was a possibility of using force, as well as whether the issues at stake at the moment justify the effort on the part of those who are threatening. It adds, as characteristics to evaluate the probability of deterration occurring, the power of action that can be generated against the deterrent, and the ability of the deter to resist or retaliate. It also emphasizes that, in addition to having credibility, the costs of those performing the dissuasion must be lower than those suffering, both considering the consequences of not acting and the costs of acting.

Mearsheimer (1985) states that decision-makers, when analyzing whether or not they go to war, are primarily concerned with determining likely outcomes when the strike forces meet the defense forces, weighing the value of the desired political objective concerning the risks and costs of a military campaign to achieve them, as well as the likelihood of success of the decade.

The cost of the war includes military and civilian casualties, lost or damaged equipment, and the costs of mobilizing, unfolding, and maintaining forces. Of course, politicians and the military try to keep these costs as low as possible. However, how much cost they are willing to tolerate is inversely proportional to the probability of deterrents working, i.e., a country prepared to bear heavy losses is more likely not to be intimidated when it intends to initiate a conflict (MEARSHEIMER, 1985).

A summary of what is understood as pillars for dissuasion to happen has been presented in the literature as "The Three C's of Dissuasion" (MCDC COUNTERING HYBRID WARFARE PROJECT, 2019; MUELLER, 2000):

the credibility that there is a willingness to carry out actions that impose costs on the adversary;

ability to carry out these actions;

communication of this will and capacity.

THE GROUND-BASED AIR DEFENSE: -

Pape (1996) investigated airpower to generate behavior changes through punishment and denial during conflicts. The author aligns himself with Freedman's understanding (2004) when he considers denial more efficient than punishment.

In the Gulf War as a more expressive example, since the air campaign in Kuwait succeeded in undermining the critical principles of Iraq's military strategy, immobilizing Iraqi mobile reserves and preventing the distribution of Iraqi supplies in the invaded territory, breaking the disposition of frontline units to fight and the ability of reserve forces to counterattack.

Still, Aron (2018) argues also that ground-based air defense means deterrents since they put the opponent's aircraft at risk, forcing them to apply resources both in obtaining means of protection for aircraft and in armaments that can be used at great distances, thereby increasing, their costs.

An important peculiarity of armed conflicts is that, while ground forces seek victory by destroying the psychological bonds of enemy troops, disorganizing them, the navies and air forces aim at the physical destruction of enemy means. Thus, the superiority of the material becomes a critical deterrent and leads the disadvantaged to avoid combat (Beaufre, 2016).

Mearsheimer (1985), analyzing the use of surface-to-air missiles in ground-based air defense, realized that they increase the possibility of dissuasion working. The author bases this assertion on the fact that these defense systems, especially if acting in conjunction with aerial means, can form a "wall of fire" (MEARSHEIMER, 1985, p. 201) in which an attacking potential can only penetrate for a very high price. Thus, as the attacker seeks to use his armed forces jointly in the various environments of the theater of operations, the impossibility of the enemy aviation achieving its objectives discourages all offensive maneuvering.

Shermann (2002, p. 209) says "the vast importance of some localities in war demands that they be protected to the utmost and asserts It must be remembered that in war the ideal is never attained, and seldom approached; where destruction is impracticable, often neutralization will prove an acceptable substitute".

Werrel's (1998) classic literature puts anti-aircraft in evidence when analyzing post-world war conflicts. The author reports that ground-based air defenses have been a problem for Airmen almost from the onset of manned flight. He argues that ground-based air defenses have made air operations more dangerous, costly and complex as it continues.

DISCUSSION AND IMPLICATIONS :-

The present work aimed to investigate the current approaches to desuasion, more specifically on the relationship between desuasion and anti-aircraft defense, in order to reveal important nuances about the possibility of these means of defense being employed in order to influence the decision-making process of a possible opponent who is analyzing whether or not a conflict starts. Supported in the theorists studied, as a deterrent such as Beaufre (1998); Aron, Bath & Paim (2018); Freedman (2004), Mearsheimer (1985), Pape (1996), Schelling, 2008 and Snyder (1959), it can be said that conventional desuasion points to a national and military strategic posture that can generate the opponent, interested in initiating a friction or situation of belligerence, inaction, through the conclusion that the consequences will be too costly for him.

In this article, we investigated conventional deterrence and ground-based air defense systems. Despite the crucial military applications, there are implications for civil aviation as well (Dias, 2019; 2019b; 2019c; Dias and Lopes, 2019) , once defense systems are directly responsible for enforcing the protection of airspace, as advocated by the Chicago Convention 1944, created to "preserve friendship and understanding among the nations and peoples of the world, yet its abuse can become a threat to the general security." (ICAO, 2021, p.1)

In order for Brazil to maintain the position of a country that values the peaceful resolution of conflicts, it is necessary that it can deter the rulers of potential opponents from starting a conflict, through an ability to defend against a presumed aggression; in addition to having credibility, along with likely opponents, that the rulers are determined to employ the means necessary for the protection of the nation; as well as to communicate that capacity and determination appropriately, while maintaining uncertainty in potential opponents about how much capacity will be employed.

The Brazilian high management has taken actions to acquire anti-aircraft defense systems of greater scope than those currently used by the Armed Forces. Such actions both contribute to credibility, since they demonstrate

institutional involvement with the theme of defense and to capacity if they result in the acquisition of the new systems. In addition, the fact that the stages of this process are being disclosed in the Official Gazette contributes to the communication. The systems that will be acquired will also allow the use of uncertainty as a deterrent tool, if they have characteristics that allow their use flexibly, such as different ranges and guidance systems, as well as tactical and strategic mobility.

The insertion of medium and long-range anti-aircraft systems also reinforces dissuasion in the extent that influences two variables that a potential adversary considers while developing his decision-making process of going to war or not: the probability of victory and costs. Since combat aircraft have contributed significantly to the development of conflicts in a manner favorable to those who operate them effectively, the destruction of fighters by opposing surface-to-air weaponry proves to be a very favorable cost-benefit ratio to the side that employs surface-to-air missiles. Moreover, as, in air combat, the superiority of the material by the opponent leads to the one at a disadvantage to avoid combat, in order to prevent the loss of his own means, an anti-aircraft system capable of causing heavy casualties to the opponent can simply make him give up starting a brawl.

As has been seen, the dissuasion that a country can generate in its possible opponents is linked to the defense strategy adopted by the nation, which involves a phase of preparation for the development of the necessary capabilities, in order to deprive the opponent of taking initiatives that lead to success. In this sense, in addition to restricting the use of airspace by the opponent, the anti-aircraft can have a broader effect, because, considering that the armed forces of the various areas act together, the impossibility of the adversary being able to provide air support to the operations of its surface media can discourage aggressive action as a whole.

DISCUSSION AND IMPLICATIONS :-

The present research allowed the perceived importance of dissuasion and anti-aircraft defense in conflict prevention, highlighting the importance of the participation of a country's senior management in decisions related to the implementation of strategies that generate deterrent effects on potential opponents. However, for dissuasion to be effective, the need to contemplate aspects related to capacity, credibility, communication and uncertainty became evident to lead hostile rulers to address the cost-benefit ratio of initiating action against the national territory as unfavorable. Future studies can deepen the aspects seen here through the realization of case studies, analyzing countries at risk of being attacked, and using anti-aircraft defense as a deterrent during the elaboration and implementation of their defense strategies to avoid the outbreak of conflicts.

For future research, we encourage an investigation on conventional deterrence and ground-based air defense systems from different countries, like Russia and the United States, for instance. In addition, single or multiple case studies are encouraged to be investigated in future studies.

CONCLUSION AND FUTURE RESEARCH:-

The present research allowed the perceived importance of dissuasion and anti-aircraft defense in conflict prevention, highlighting the importance of the participation of a country's senior management in decisions related to the implementation of strategies that generate deterrent effects on potential opponents. For this dissuasion to be effective, it became evident the need to contemplate aspects related to capacity, credibility, communication and uncertainty, in order to lead hostile rulers to address as unfavorable the cost-benefit ratio of initiating action against the national territory. Future studies can deepen the aspects seen here, through the realization of case studies, analyzing countries that were at risk of being attacked and that used anti-aircraft

defense as a deterrent during the elaboration and implementation of their defense strategies, in order to avoid the outbreak of conflicts.

For future research, we encourage the undertaking of an investigation on conventional deterrence and ground-based air defense systems from different countries, like Russia and the United States, for instance. Single or multiple case studies are also object for future research.

REFERENCES:-

Aron, R., Bath, S., & Paim, A. (2018). *Peace and war between nations* [S.l.]: WMF Martins Fontes. Disponível em: <<https://books.google.com.br/books?id=PuVmDwAAQBAJ>>.

Baptista Júnior, C. A. (2021) *Diretriz do Comandante da Aeronáutica 2021 – 2022*. Brasília, DF.

Beaufre, A. (2016) *Introduction to strategy*. [S.l.]: BIBLIEX COOPERATIVA, 2016. Disponível em: <<https://books.google.com.br/books?id=NfHamwEACAAJ>>.

Brasil (1998) *Constituição da República Federativa do Brasil de 1988*. Brasília: Centro Gráfico, 1988. Disponível em: <http://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm>. Acesso em: 09 ago 2021.

Brodie, Bernard (1946). *The Absolute Weapon: Atomic Power and World Order, by Frederick S. Dunn (And Others)*. Edited by Bernard Brodie. [S.l: s.n.].

Dias, M. (2019). Brasilia International Airport and the Evolution of Civil Aviation in Brazil. *East African Scholars Journal of Economics, Business and Management*, 2(12), 734-737. doi: 10.36349/EASJEBM.2019.v02i12.038

Dias, M. (2019b). Santos Dumont Airport: Civil Aviation in Rio de Janeiro, Brazil. *Saudi Journal of Engineering and Technology*, 4(10), 418-421. doi: 10.36348/SJEAT.2019.v04i10.004

Dias, M. (2019c). Air Passenger Transportation in Brazil. *Global Scientific Journals*. 7(10), 310-317. doi: 10.13140/RG.2.2.26800.71688

Dias, M.; Lopes, R. (2019). The Evolution of Civil Aviation in Brazil: Rio de Janeiro International Airport Galeão/Tom Jobim. *JResLit Journal of Science and technology*, 1(2), 1-6. doi: 10.13140/RG.2.2.15920.10242

Freedman, L. (2004). *Deterrence*. [S.l.]: Wiley. Disponível em: <<https://books.google.com.br/books?id=iR88PE1EJy0C>>. (Themes for the 21st Century Series).

ICAO (2021) Convention on International Civil Aviation - Doc 7300. Retrieved from <https://www.icao.int/publications/pages/doc7300.aspx>, on 12 August 2021.

MCDC Countering Hybrid Warfare Project. *Deterring hybrid aggressors*. MCDC Countering Hybrid Warfare Project: Countering Hybrid Warfare, March 2019. Disponível em: <<https://www.ugr.es/~jjordan/MCDC-Countering-%20Hybrid-Warfare.pdf>>. Acesso em: 17 maio 2021.

Mearsheimer, J.J. *Conventional Deterrence*. [S.l.]: Cornell University Press, 1985. Disponível em: <<https://books.google.com.br/books?id=lNwZDgAAQBA>>. (Cornell studies in security affairs).

Ministério da Defesa (2016). *Política Nacional de Defesa*. [S.l.]: Brasília, DF. Disponível em: <https://www.gov.br/defesa/pt-br/assuntos/copy_of_estado-e-defesa/pnd_end_congresso_.pdf>. (EM interministerial).

Ministério da Defesa (2017). *Cenários de Defesa 2020-2039: sumário executivo*. [S.l.: s.n.]. Disponível em: <https://www.gov.br/defesa/pt-br/assuntos/copy_of_estado-e-defesa/revista_cenario_de_defesa.pdf>.

Ministério da Defesa (2020a) PORTARIA Nº 4.181/GM-MD. *Aprova os Requisitos Operacionais Conjuntos (ROC) para o Sistema de Artilharia Antiaérea de Média Altura /Médio Alcance das Forças Armadas - ROC Nº 54/2020*. p. 1, 11 Dez 2020. Brasília, DF.

Ministério da Defesa (2020b). PORTARIA Nº 109/EMCFA-MD. *Constitui o Grupo de Trabalho (GT) com a finalidade de confeccionar os Requisitos Operacionais Conjuntos (ROC) para Sistemas de Artilharia Antiaérea de média altura/médio alcance*. p. 1, 10 Jan 2020. Brasília, DF.

Ministério da Defesa (2020c). PORTARIA Nº 1.618/EMCFA-MD. *Constitui o Grupo de Trabalho (GT) com a finalidade de definir os limites de responsabilidade de controle operacional sobre a Defesa Antiaérea no SISDABRA e no Teatro de Operações (TO), atentando para a necessidade de implementação da coordenação por área*. Brasília, DF. Disponível em: <<https://www.jusbrasil.com.br/diarios/294391811/dou-secao-2-24-04-2020-pg-5>>. Acesso em: 2 jul 2021c.

Ministério da Defesa (2020d). PORTARIA Nº 108/EMCFA-MD. *Constitui o Grupo de Trabalho (GT) com a finalidade de confeccionar os Requisitos Operacionais Conjuntos (ROC) para Sistemas de Artilharia Antiaérea de grande altura/longo alcance*. Brasília, DF. Disponível em: <<https://www.jusbrasil.com.br/diarios/278293343/dou-secao-2-13-01-2020-pg-5>>. Acesso em: 2 jul 2021.

Ministério da Defesa (2021). *Resolução CONSUG-MD Nº 9, DE. Aprova a designação do Exército Brasileiro como Força Líder na condução do processo de obtenção do Sistema de Artilharia Antiaérea de Média Altural/Médio Alcance*. Brasília, DF. Disponível em: <<https://www.in.gov.br/web/dou>>. Acesso em: 2 jul 2021.

Ministério da Defesa. Exército Brasileiro (2021). *Grupo de Artilharia Antiaérea - Manual de Campanha - EB70-MC-10.365*. [S.l.: s.n.]. Brasília, DF.

Pape, Robert Anthony (1996). *Bombing to win: air power and coercion in war*. Ithaca, N.Y: Cornell University Press, 1996. (Cornell studies in security affairs).

Schelling, T.C. *Arms and Influence*. [S.l.]: Yale University Press, 2008. Disponível em: <https://books.google.com.br/books?id=TX_yAAAAQBA>. (The Henry L. Stimson Lectures Series).

Sherman, William C. & Press, Air University (U.S.) (2002). *Air Warfare*. Air University Press. Maxwell Air Force Base, Alabama, 2002. Disponível em: <https://media.defense.gov/2017/Mar/31/2001725079/-1/-1/0/B_0086_SHERMAN_AIR_WARFARE.PDF>

Snyder, G.H. *Deterrence by Denial and Punishment*. [S.l.]: Woodrow Wilson school of Public and International Affairs, Center of International Studies, Princeton University, 1959. Disponível em: <<https://books.google.com.br/books?id=MTIZAAAIAAJ>>. (Center of international studies, Princeton university, v. 2, N^o 7).

Vegécio, Flávio Renato (1995). *A Arte Militar*. São Paulo: Editora Paumape S.A., 1995.

Werrell, K.P. & Press, Air University (U.S.) (2005). *Archie to SAM: A Short Operational History of Ground-based Air Defense*. [S.l.]: Air University Press, 2005. Disponível em: <https://books.google.com.br/books?id=8_nsAQAACAAJ>.

© GSJ