



## **MODEL FOR IMPLEMENTING NATIONAL AIRSPACE CONTROL POLICY AT THE NATIONAL AIR OPERATIONS COMMAND (KOOPSUDNAS)**

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### **Abstract**

This study aims to analyze the implementation of the national airspace control policy within the National Air Operations Command (Koopsudnas), identify the factors influencing its implementation, and formulate an integrative, adaptive, and responsive model to strengthen the monitoring and enforcement of Indonesia's airspace sovereignty. The research was conducted at Koopsudnas and relevant institutions authorized to manage and control national airspace. The study population comprised organizational elements and relevant stakeholders, involving 233 respondents as the quantitative sample and 15 informants purposively selected based on their competence, experience, and involvement in policy implementation. A mixed-methods approach was employed, with data collected through questionnaires, interviews, observations, and document analysis. Quantitative data were analyzed using multiple linear regression, t-tests, F-tests, and the coefficient of determination, while qualitative data were analyzed using an interactive analytical approach. The findings indicate that the three variables simultaneously exert a significant influence on policy implementation ( $F = 13.406$ ;  $\text{Sig.} = 0.000$ ). The Ability of Statute and Nonstatutory Variables demonstrated significant positive effects, whereas Tractability was not statistically significant. These findings suggest that implementation success is primarily influenced by regulatory capacity and environmental factors, while problem characteristics have not significantly affected policy implementation. The study recommends the IAR Model through the integration of regulations, authority, institutions, technology, information, human resources, coordination, and periodic evaluation.

**Keywords:** *Policy Implementation; Airspace Control; National Security; Defense Governance*

### **INTRODUCTION**

National airspace control constitutes a strategic component of national defense because it is closely associated with sovereignty, national security, aviation safety, law enforcement, and the protection of national interests (Onduko, 2025). For Indonesia, as an archipelagic country with an extensive airspace and a strategically important geographical position, airspace management presents complex challenges (Omotosh, 2025).



Airspace is simultaneously utilized for civilian and military purposes, transportation, economic activities, communication, and various other functions (Gavrillo & Pobochoenko, 2021). These conditions require policies capable of regulating diverse interests while ensuring that all activities within national airspace remain within the framework of state sovereignty and national security. Therefore, airspace control should be understood as a policy process involving the integrated management of regulations, organizations, human resources, technology, information, coordination, and decision-making (Budiman, 2023).

The challenges of airspace control have become increasingly complex due to developments in aviation technology and changes in the strategic environment (Linh et al., 2024). The growing use of unmanned aerial vehicles (UAVs), digital communication systems, surveillance sensors, information networks, and emerging forms of hybrid threats requires defense organizations to possess a high level of adaptive capacity (Jasper, 2024). The rapid pace of technological change means that conventional surveillance patterns are not always sufficient to address increasingly dynamic threat characteristics (Stasiev et al., 2025). Under these conditions, the success of airspace control is determined not merely by the availability of defense equipment and radar systems but also by the organizational capacity to integrate information, identify objects, assess threat levels, make decisions, establish coordination, and execute responses rapidly and accurately (Jarvis & Martin, 2024).

These empirical challenges are reflected in the research data, which indicate that 47 airspace violation incidents occurred during the 2020–2025 period. Response times to such incidents ranged from 15 to 30 minutes, while approximately 68 percent of the 62 radar units forming part of the surveillance system were operating under optimal conditions (Zhao et al., 2024). These data illustrate that national airspace surveillance capacity continues to face significant challenges. The issue is not solely related to the number of available systems or the level of technological readiness but also concerns how these resources are connected to procedures, authority structures, coordination mechanisms, human resources, information systems, and command-and-control arrangements (Kosova et al., 2021). Consequently, the central research problem shifts from merely questioning the availability of facilities toward examining the effectiveness of policy implementation in generating operational action.

Institutionally, the National Air Operations Command (Koopsudnas) occupies a crucial position in carrying out air defense functions and maintaining national airspace security (Lipatov et al., 2023). The implementation of these responsibilities takes place within an institutional environment involving various actors, including elements of the Indonesian National Armed Forces (TNI), ministries, government agencies, air navigation service providers, and other relevant institutions (Yefimenko et al., 2023). This condition creates a need for clear divisions of authority, consistent procedures, effective communication, rapid information exchange, and cross-organizational coordination (Ledger, 2025). When institutions operate according to sectoral perspectives, delays in information exchange, overlapping authority, procedural differences, and coordination gaps may undermine the effectiveness of airspace control (PREDA et al., 2024).



From a regulatory perspective, this study is primarily grounded in Law Number 21 of 2025 concerning Airspace Management (Hardwick et al., 2025). The law defines airspace management as a series of activities encompassing planning, utilization, control, and supervision (Haoyang & Kharchenko, 2023). Article 3 paragraph (1) emphasizes that airspace management aims to establish synergy in management while ensuring sovereignty, security, safety, and the beneficial utilization of airspace (Iwata et al., 2025). Furthermore, Article 3 paragraph (2) highlights the importance of synergy through cooperation among ministries, institutions, and society (Kim et al., 2022). These provisions demonstrate that airspace management requires an integrated approach and cannot be implemented by a single institution alone. Article 5 provides the legal basis for Indonesia's sovereignty over its airspace, while Article 10 regulates airspace management through the functions of planning, utilization, control, and supervision (Menzenski et al., 2023). Provisions concerning defense and security interests in Article 19 further reinforce the relevance of airspace control as an essential component of maintaining national sovereignty and security (Tupitsya et al., 2025).

This legal foundation is reinforced by Law Number 3 of 2002 concerning National Defense (Silva, 2021). Article 10 paragraph (1) establishes the TNI as an instrument of national defense, while paragraph (2) emphasizes its responsibility for implementing national defense policy (Turchetti & Murça, 2024). These provisions are relevant to this study because the implementation of airspace control constitutes part of the execution of national defense responsibilities. At the institutional level, Regulation of the Commander of the Indonesian National Armed Forces Number 60 of 2025 concerning the Organization and Duties of Koopsudnas provides the legal basis for the position and functions of Koopsudnas, including the conduct of air defense operations, law enforcement, and the safeguarding of national airspace security (Windhorst et al., 2024). This legal framework indicates that relatively clear policy and institutional foundations are available from a normative perspective. However, the existence of regulations does not automatically guarantee successful implementation (Gédrová et al., 2024). The subsequent challenge concerns how these provisions are translated into organizational capacity and operational action.

Previous studies indicate that research on airspace management has developed across several areas, including air defense, aviation security, UAV utilization, surveillance effectiveness, organizational capacity, system interoperability, civil-military cooperation, and the use of information technology (Berman et al., 2023). These studies demonstrate that technology, organizational capacity, human resources, and coordination are closely related to the effectiveness of airspace control (Lucas, 2022). However, previous research has generally examined these dimensions separately. Studies that specifically integrate problem characteristics, the capacity of regulations to structure implementation, nonstatutory environmental factors, institutional capacity, technology, human resources, and coordination into a single policy implementation model within Koopsudnas remain limited (Halak et al., 2024). This condition constitutes the state of the art of the present study.



This study adopts the policy implementation perspective developed by Mazmanian and Sabatier, which encompasses three principal dimensions: *Tractability of the Problem*, *Ability of Statute to Structure Implementation*, and *Nonstatutory Variables Affecting Implementation* (Pinti, 2024). *Tractability of the Problem* is used to understand the level of complexity associated with the issues that must be addressed (Alitz et al., 2025). *Ability of Statute to Structure Implementation* is employed to examine the capacity of regulations to provide direction, authority, procedures, and implementation structures (ZALEVSKYI & CHORNOGOR, 2021). Meanwhile, *Nonstatutory Variables Affecting Implementation* are used to explain the influence of factors beyond formal legal provisions, including organizational conditions, leadership, resources, institutional support, technology, coordination, and the strategic environment (Litton et al., 2024). The use of these three dimensions enables the study to examine policy implementation more comprehensively.

The research gap lies in the still suboptimal relationship between policy design and implementation capacity at the operational level. Normatively, existing regulations have provided direction for airspace management and control; however, practical challenges remain, including airspace violations, response times, surveillance system readiness, information integration, and inter-institutional coordination (BAŞBUĞ et al., 2021). Therefore, a gap exists between what is designed within policy and what can be realized through operational action (Gnatyuk et al., 2024). This study seeks to address this gap by combining quantitative and qualitative approaches, thereby enabling the relationships among variables to be empirically tested and simultaneously explained based on organizational conditions.

The research findings indicate that *Tractability of the Problem*, *Ability of Statute to Structure Implementation*, and *Nonstatutory Variables Affecting Implementation* simultaneously exert a significant influence on policy implementation, with an F-value of 13.406 and a significance value of 0.000 (Notari, 2025). Partially, *Ability of Statute to Structure Implementation* and *Nonstatutory Variables Affecting Implementation* have positive and significant effects (Will & Vance, 2022), whereas *Tractability of the Problem* does not demonstrate a statistically significant effect. *Nonstatutory Variables Affecting Implementation* emerged as the most dominant factor (Gussow, 2021). These findings indicate that successful implementation is not determined solely by the characteristics of the problems being addressed but is strongly influenced by the capacity of regulations to provide an implementation structure and, more importantly, by the implementation environment, organizational capacity, resources, technology, leadership, and coordination.

Based on these findings, the novelty of this study is reflected in the development of the Integrative, Adaptive, and Responsive (IAR) Policy Implementation Model (Jain et al., 2025). This model integrates regulations, authority, institutional arrangements, technology, information, human resources, coordination, and command-and-control systems into a unified implementation framework. The IAR Model is designed as a cycle connecting the processes of detection, identification, verification, decision-making, coordination, action, evaluation, and adaptation



(Brewster, 2022). This integration is expected to reduce the gap between policy and implementation while enhancing organizational capacity to respond to changes in the strategic environment and technological developments.

Based on these issues, the research questions focus on how the national airspace control policy is implemented within Koopsudnas; how *Tractability of the Problem*, *Ability of Statute to Structure Implementation*, and *Nonstatutory Variables Affecting Implementation* influence policy implementation, both partially and simultaneously; which factors support and hinder policy implementation; and how an integrative, adaptive, and responsive implementation model can be developed. The initial hypothesis proposes that the three variables influence policy implementation. The alternative hypothesis states that the three variables have positive and significant effects on policy implementation, both partially and simultaneously. The initial proposition suggests that implementation effectiveness increases when problem characteristics can be managed, regulations are capable of providing a clear implementation structure, and environmental factors support policy implementation (Neto et al., 2024). The alternative proposition suggests that implementation environmental factors may become the primary determinants of success when technological developments and changes in the strategic environment occur more rapidly than the capacity of organizations and regulations to adapt (Lei & Zhou, 2024).

This study aims to analyze the implementation of the national airspace control policy within Koopsudnas, examine the influence of the three dimensions of policy implementation, identify supporting and inhibiting factors, and develop an implementation model capable of strengthening the effectiveness of airspace control. Theoretically, the study contributes to the development of policy implementation research within the context of defense and security. Practically, the findings may serve as an evaluative basis for strengthening coordination, information systems, human resources, surveillance technology, and command-and-control systems. From a policy perspective, the findings may provide input for strengthening regulatory harmonization and inter-institutional cooperation.

The study is limited to the policy implementation aspects of national airspace control within the context of Koopsudnas and does not examine in detail military operational tactics, defense equipment configurations, or classified defense information. The research focuses on policy, institutions, resources, technology, information, coordination, and implementation capacity. Future research may further develop the IAR Model through longitudinal approaches, *big data analytics*, *system dynamics*, and *social network analysis* to measure information integration, coordination patterns, response speed, and organizational adaptive capacity (Carvin, 2021). Comparative studies involving the airspace control systems of other countries are also important for identifying best practices (Gordienko, 2024). Accordingly, this study is intended not only to explain policy implementation challenges but also to develop a model capable of strengthening national airspace control in an integrative, adaptive, and responsive manner.

**METHODOLOGY**

This study employed a *mixed-methods* approach using a *sequential exploratory* design (Bazyliuk & Nazarenko, 2024), conducted through two main stages beginning with the exploration of qualitative data and followed by quantitative testing. This approach was selected because the implementation of the national airspace control policy represents a phenomenon involving interrelated organizational, institutional, regulatory, coordination, technological, and human resource dimensions. Therefore, an understanding of the research phenomenon cannot rely solely on numerical data but requires in-depth information concerning experiences, authority, coordination patterns, decision-making processes, and interactions among relevant actors. The qualitative stage was used to obtain an empirical understanding of the policy implementation process, whereas the quantitative stage was employed to test the relationships among variables in a measurable manner (Kalbani et al., 2024). The integration of these two approaches was expected to provide a more comprehensive understanding of the implementation of the national airspace control policy.

The study population comprised organizational elements and stakeholders directly or indirectly involved in the implementation of the national airspace control policy within the National Air Operations Command (Koopsudnas). These elements included leaders and personnel of Koopsudnas, relevant Indonesian Air Force units, the Ministry of Defense, the Ministry of Transportation, the Directorate General of Civil Aviation, AirNav Indonesia, and other agencies or institutions with authority and interests related to the management, supervision, security, and control of national airspace. The determination of this population was based on the consideration that policy implementation is not carried out by a single organization but involves multiple actors with different functions, authorities, and interests (Devi, 2024).

At the quantitative stage, the study involved 233 respondents as the research sample. The respondents represented various institutional elements associated with the implementation of the national airspace control policy. The distribution consisted of 60 respondents from the leadership and personnel of Koopsudnas (25.75%), 45 respondents from relevant Indonesian Air Force units (19.31%), 25 respondents from the Ministry of Defense (10.73%), 20 respondents from the Ministry of Transportation (8.58%), 25 respondents from the Directorate General of Civil Aviation (10.73%), 30 respondents from AirNav Indonesia (12.88%), and 28 respondents from other relevant agencies or institutions (12.02%). The overall distribution comprised 233 respondents, representing 100% of the sample. The respondents were surveyed to obtain empirical data regarding policy implementation based on the three principal variables within the Mazmanian and Sabatier perspective, namely *Tractability of the Problem*, *Ability of Statute to Structure Implementation*, and *Nonstatutory Variables Affecting Implementation* (Madhupriya, 2025).

The qualitative stage involved 15 key informants selected using a *purposive sampling* technique (Umer et al., 2022). Informants were selected based on their competence, authority, experience, knowledge, and involvement in the implementation of the national airspace control



policy. The composition of informants included three leaders or officials from Koopsudnas, three personnel or representatives from relevant Indonesian Air Force units, two informants from the Ministry of Defense, two informants from the Ministry of Transportation and the Directorate General of Civil Aviation, two informants from AirNav Indonesia, and three informants from other relevant agencies or institutions. These informants were selected to obtain in-depth information regarding implementation processes, coordination, the division of authority, obstacles, supporting factors, and the effectiveness of policy implementation. If the information obtained was insufficient, the selection of additional informants could be expanded through *snowball sampling* until data adequacy and saturation were achieved (Demirbilek, 2022).

Data were collected through in-depth interviews, observation, questionnaires, and document analysis (Zeng, 2021). Interviews were conducted to explore the experiences and perspectives of relevant actors regarding policy implementation, coordination mechanisms, communication, the distribution of authority, decision-making processes, and various challenges arising in airspace control. Observation was employed to obtain direct insights into coordination processes and the implementation of relevant activities. Questionnaires were used during the quantitative stage to collect measurable data concerning respondents' perceptions of the research variables. Meanwhile, documentation served as a source of secondary data, including policy documents, regulations, standard operating procedures (SOPs), operational reports, evaluation reports, and other documents relevant to policy implementation.

The research variables were developed based on the policy implementation model proposed by Mazmanian and Sabatier (LIU et al., 2021). These variables consisted of *Tractability of the Problem*, referring to the characteristics and degree of manageability of the problem; *Ability of Statute to Structure Implementation*, referring to the capacity of regulations to structure the implementation process; and *Nonstatutory Variables Affecting Implementation*, referring to non-regulatory variables that influence implementation. These three variables were used to analyze the various factors determining the successful implementation of the national airspace control policy. The research indicators were developed based on theoretical foundations, previous research findings, interview results, and the empirical characteristics of the research object. The quantitative instrument employed a five-point Likert scale to measure respondents' perceptions of the indicators associated with each variable (Rawal, 2023).

Data analysis was conducted in stages in accordance with the *mixed-methods sequential exploratory* design (Bjerke & Valaker, 2022). Qualitative data were analyzed through the stages of data reduction, information categorization, coding, theme identification, interpretation of relationships among themes, and conclusion drawing (Mező, 2021). The analysis was directed toward identifying implementation patterns, coordination mechanisms, the distribution of authority, communication among actors, barriers, organizational support, and other factors influencing policy implementation. The qualitative findings were subsequently used to strengthen the conceptual understanding of the phenomenon and support the quantitative testing process. Quantitative data were analyzed using descriptive statistics and analyses of relationships



among variables. Where the research model involved latent constructs, the analysis could be conducted using Structural Equation Modeling–Partial Least Squares (SEM-PLS), including the assessment of the *outer model* and *inner model*, path coefficients, *t-statistics*, *p-values*, and  $R^2$  values (John & John, 2022).

The quality of the research instruments was ensured through validity and reliability testing before hypothesis testing was conducted (Guía, 2024). Content validity was assessed through *expert judgment* involving individuals with expertise in policy, defense, airspace management, and policy implementation. In SEM-PLS analysis, convergent validity could be assessed through *outer loadings* and Average Variance Extracted (AVE), while discriminant validity was used to ensure empirical distinctions among the constructs. Instrument reliability could be tested using Cronbach's Alpha and Composite Reliability (Pope, 2021). These tests were necessary to ensure that the instruments employed were capable of generating consistent, accurate, and valid data in accordance with the research constructs.

Research ethics also constituted an important component of the study (Jackson, 2021). Researchers were required to obtain informed consent from participants before conducting interviews and administering questionnaires. The participation of respondents and informants was voluntary, and the confidentiality of informants' identities was maintained, particularly when the information provided concerned organizational weaknesses, coordination constraints, the distribution of authority, or evaluations of policy implementation. Research data were required to be stored securely and used exclusively for academic purposes. The interpretation of research findings was also conducted objectively while avoiding the stigmatization or unfair attribution of responsibility to particular individuals or institutions.

Overall, the methodology of this study was designed to integrate the strengths of qualitative and quantitative approaches in explaining the implementation of the national airspace control policy within Koopsudnas. Qualitative data obtained from 15 key informants provided an in-depth understanding of the context, mechanisms, experiences, and dynamics of implementation, whereas quantitative data collected from 233 respondents provided an empirical basis for testing the relationships among variables. The integration of these two sources of data enabled the study not only to determine whether particular factors influenced policy implementation but also to explain how the implementation process unfolded, why obstacles occurred, and which factors supported successful implementation. Accordingly, this methodology was expected to generate substantive findings that could serve as the foundation for developing an integrative, adaptive, and responsive model for implementing the national airspace control policy.

## **RESULT AND DISCUSSION**

### ***Policy Implementation Model for National Airspace Control at the National Air Operations Command (Koopsudnas)***

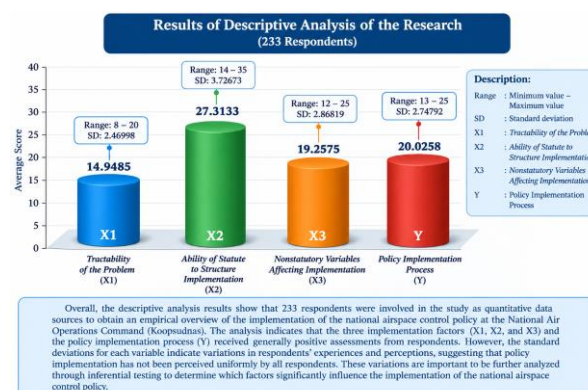
The results of the descriptive analysis indicate that the study involved 233 respondents as sources of quantitative data to obtain an empirical overview of the implementation of the national airspace control policy at the National Air Operations Command (Koopsudnas). The



analysis covered four main constructs: *Tractability of the Problem* (X1), *Ability of Statute to Structure Implementation* (X2), *Nonstatutory Variables Affecting Implementation* (X3), and the policy implementation process (Y). These four constructs were used to describe the empirical conditions of the research variables based on the perceptions of respondents involved in or associated with policy implementation.

Variable X1 had a score range of 8–20, with a mean value of 14.9485 and a standard deviation of 2.46998. These results indicate that respondents generally held positive perceptions regarding the characteristics of the problem and the degree to which it could be addressed, although differences in assessments remained among respondents. Variable X2 had a range of 14–35, a mean of 27.3133, and a standard deviation of 3.72673. The relatively high mean value suggests that the capacity of statutory provisions to structure policy implementation was perceived as reasonably strong, particularly in providing direction and an appropriate framework for policy implementation.

Furthermore, X3 had a range of 12–25, a mean of 19.2575, and a standard deviation of 2.86819. These findings indicate that nonstatutory factors, including the organizational environment, coordination, resources, and institutional conditions, were perceived as relatively supportive of the implementation process. Meanwhile, variable Y had a range of 13–25, a mean of 20.0258, and a standard deviation of 2.74792, indicating a generally positive tendency toward policy implementation. Overall, the descriptive results demonstrate that respondents provided relatively favorable assessments of the three implementation factors and the policy implementation process. However, the standard deviations across the variables indicate variations in respondents' experiences and perceptions, suggesting that policy implementation has not been perceived uniformly by all respondents. These variations are important to examine further through inferential testing to determine which factors genuinely and significantly influence the implementation of the national airspace control policy.



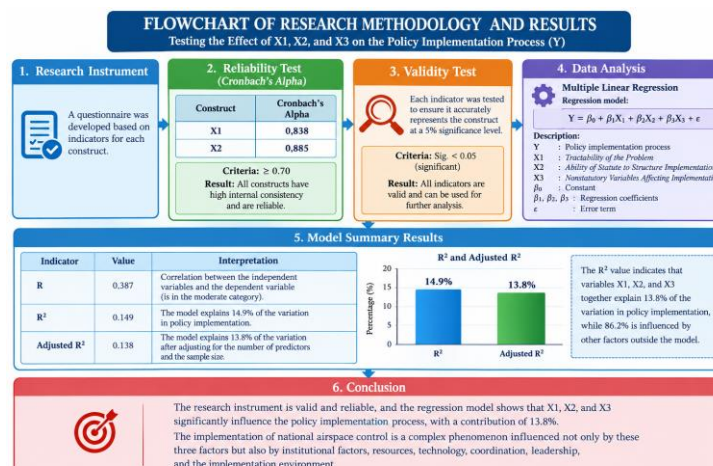
## Measurement - Model Results

The results of the *measurement/model* testing indicate that the research instrument demonstrated an adequate level of consistency for use in further analysis. Reliability testing was conducted using Cronbach's Alpha, with an acceptance threshold of  $\geq 0.70$ . Construct X1 obtained a value of 0.838, while X2 obtained a value of 0.885, indicating that both constructs



demonstrated good internal consistency. This suggests that the questionnaire items used were relatively consistent in measuring the respective research constructs.

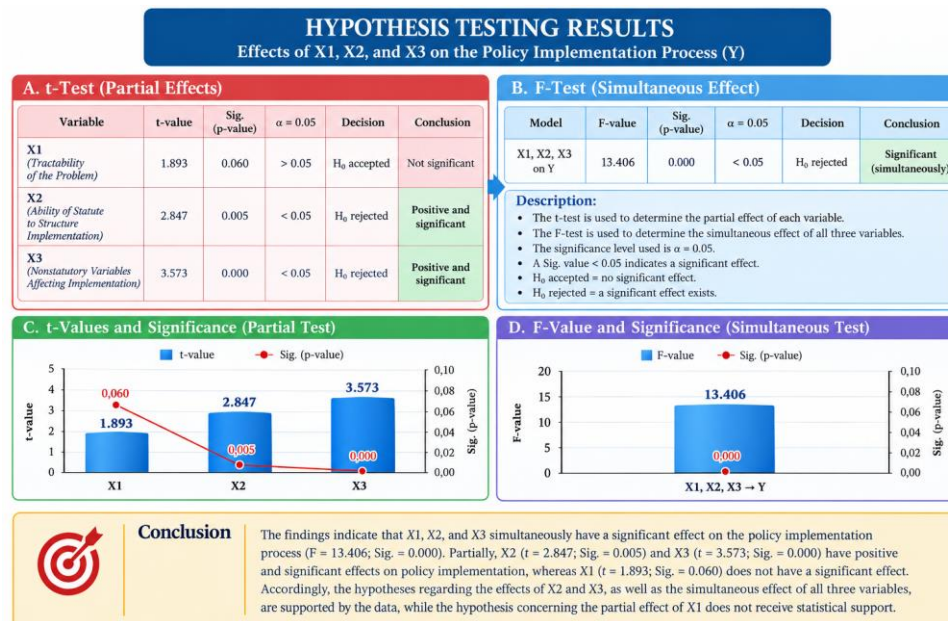
Furthermore, validity testing was conducted to ensure that each indicator accurately represented the variable being measured at a 5% significance level. The analysis of the relationships among variables was performed using multiple linear regression because the study examined the contribution of three independent variables, namely X1, X2, and X3, to the policy implementation process (Y). The *model summary* results showed an R value of 0.387, an R<sup>2</sup> value of 0.149, and an Adjusted R<sup>2</sup> value of 0.138. These findings indicate that the three independent variables collectively explained 13.8% of the variation in policy implementation, while the remaining 86.2% was influenced by other factors outside the model. This finding suggests that the implementation of the national airspace control policy is a complex phenomenon that is not determined solely by these three variables but is also influenced by institutional factors, resources, technology, coordination, leadership, and the broader implementation environment (Schimpf et al., 2022).



## Hypothesis Testing

Hypothesis testing was conducted to determine the effect of each independent variable on the implementation process of the national airspace control policy and to examine their combined effect. Partial hypothesis testing was performed using the *t-test*, while simultaneous testing was conducted using the *F-test*, with a significance level of  $\alpha = 0.05$ . The results of the F-test showed an F-value of 13.406 with a significance value of 0.000, which was lower than 0.05. These findings indicate that *Tractability of the Problem* (X1), *Ability of Statute to Structure Implementation* (X2), and *Nonstatutory Variables Affecting Implementation* (X3) simultaneously had a significant effect on the policy implementation process (Y).

Partially, X1 produced a t-value of 1.893 and a significance value of 0.060, indicating that it did not have a statistically significant effect. X2 obtained a t-value of 2.847 and a significance value of 0.005, demonstrating a positive and significant effect. Meanwhile, X3 obtained a t-value of 3.573 and a significance value of 0.000, confirming a positive and significant effect. Therefore, X2 and X3 received empirical support as significant determinants of policy implementation, whereas X1 did not demonstrate a statistically significant partial effect.



The main findings of this study indicate that the implementation of the national airspace control policy is a complex process and is not determined solely by the characteristics of the problem. The analysis shows that *Nonstatutory Variables Affecting Implementation* (X3) emerged as the most dominant factor, with a Beta value of 0.234, followed by *Ability of Statute to Structure Implementation* (X2), with a Beta value of 0.181. Meanwhile, *Tractability of the Problem* (X1) had a Beta value of 0.121 but did not demonstrate a statistically significant partial effect. These findings highlight the importance of considering the conditions of the implementation environment, institutional capacity, coordination, resources, and organizational factors (Tebekin, 2022).

Based on the integration of the quantitative and qualitative findings, this study developed the Integrative, Adaptive, and Responsive (IAR) Policy Implementation Model. The integrative dimension emphasizes the interconnectedness of regulations, authority, institutional arrangements, technology, information, human resources, and coordination. The adaptive dimension emphasizes the capacity to adjust procedures and organizational capabilities in response to changes in the strategic and operational environment. Meanwhile, the responsive dimension emphasizes the speed and effectiveness of detection, identification, analysis, decision-making, action, and evaluation. The results of the evaluation subsequently serve as feedback for the continuous improvement and refinement of policy implementation.

### Policy Implementation Model for National Airspace Control at the National Air Operations Command (Koopsudnas)

The findings indicate that the implementation of the national airspace control policy at the National Air Operations Command (Koopsudnas) is a complex and multidimensional process. Policy implementation cannot be explained solely by the existence of regulations or the technical capabilities of air defense; rather, it is influenced by the interaction between problem



characteristics, the capacity of policy instruments to structure the implementation process, and various factors beyond formal regulations (Menon & Iyer, 2024). The empirical findings demonstrate that the three variables within the Mazmanian and Sabatier framework *Tractability of the Problem* (X1), *Ability of Statute to Structure Implementation* (X2), and *Nonstatutory Variables Affecting Implementation* (X3) collectively have a significant effect on the policy implementation process. This is indicated by an F-value of 13.406 with a significance level of 0.000, demonstrating that the three variables simultaneously have a significant relationship with the implementation of the national airspace control policy.

Although the three variables collectively influence policy implementation, the results of the partial tests reveal different patterns of influence. The *Tractability of the Problem* variable obtained a significance value of 0.060 and therefore did not demonstrate a statistically significant effect at the  $\alpha = 0.05$  level. This finding suggests that the characteristics or level of complexity of airspace-related problems do not independently constitute the primary determinant of successful implementation. Airspace complexity indeed involves extensive territorial coverage, dense aviation activity, potential violations, developments in aviation technology, and evolving threat dynamics. However, the existence of these challenges does not automatically determine whether a policy will succeed or fail. More decisive factors include how organizations translate these challenges into policy capacity, coordination, resources, technology, authority, and operational actions.

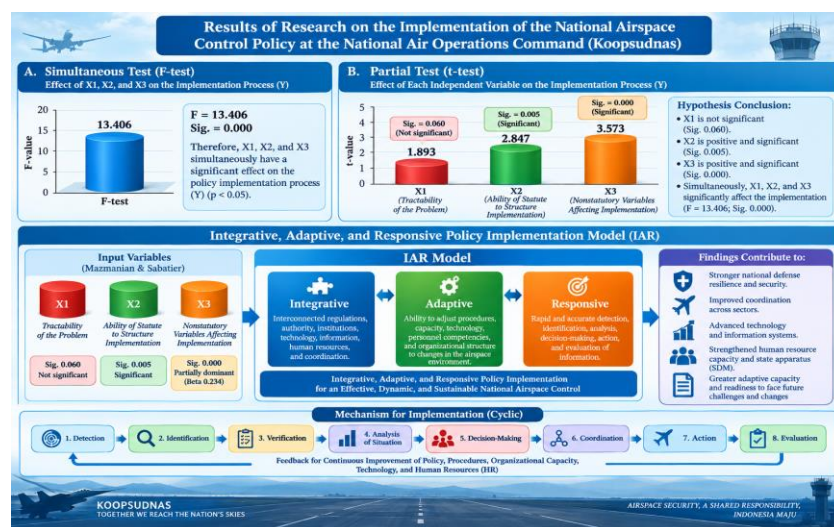
The *Ability of Statute to Structure Implementation* variable demonstrated a positive and significant effect, with a significance value of 0.005. This finding indicates that the clarity and capacity of regulations to provide an appropriate structure for implementation play an important role in national airspace control (Hawley, 2021). Regulations provide the foundation for the distribution of authority, the allocation of responsibilities, implementation procedures, coordination mechanisms, and organizational direction. However, regulations cannot operate independently. Their effectiveness depends on the capacity of implementing actors to translate normative provisions into operational procedures and actions. Therefore, the quality of implementation is determined not only by the existence of regulations but also by the ability of organizations to ensure that these regulations are implemented consistently under dynamic operational conditions.

The most important finding concerns the *Nonstatutory Variables Affecting Implementation* (X3), which demonstrated the most dominant influence, with a significance value of 0.000 and a Beta coefficient of 0.234. The dominance of X3 indicates that factors beyond the formal regulatory structure play a substantial role in determining implementation success (ROMAN, 2022). These factors include the organizational environment, human resource capacity, technology, institutional support, communication, inter-organizational coordination, leadership, and broader implementation conditions. In the context of Koopsudnas, airspace control involves multiple actors and systems that must operate in a coordinated manner. Therefore, successful implementation is strongly influenced by the organization's ability to establish effective working relationships, provide adequate resources, integrate information, and make decisions rapidly and accurately.



Based on the integration of the quantitative and qualitative findings, this study developed the Integrative, Adaptive, and Responsive (IAR) Policy Implementation Model. The model was developed to address the requirements of policy implementation within an airspace control environment characterized by strategic importance, dynamic conditions, and the need for cross-organizational coordination. The integrative dimension emphasizes the interconnectedness of regulations, authority, institutional arrangements, technology, information, human resources, and coordination. The adaptive dimension emphasizes the ability of organizations to adjust procedures, technology, personnel competencies, and organizational structures in response to changes in the airspace environment. Meanwhile, the responsive dimension emphasizes the capacity to produce rapid, accurate, coordinated, and information-based actions.

The IAR Model can further be understood as a cyclical mechanism. The implementation process begins with detection, followed by identification, verification, situational analysis, decision-making, coordination, action, and evaluation. The results of the evaluation do not merely serve as a final report but are used as feedback to improve policies, procedures, organizational capacity, technology, and human resource competencies. Through this pattern, policy implementation is not viewed as a linear process that simply moves from regulation to action, but rather as a continuous process that enables organizations to learn and adapt to changing conditions (T et al., 2021).



## Comparison of Previous Studies, Theoretical Contributions, Practical Implications, and the Novelty of the IAR Model

The findings of this study both reinforce and extend previous research on airspace control. Abbas et al. (2024) and Amrin et al. (2025) primarily focused on the effectiveness of surveillance and air defense strategies. Leksono et al. (2022) and Paulov (2023) placed greater emphasis on operational capabilities and airspace capacity. Meanwhile, Koloay and Arinanto (2022) identified civil–military cooperation as an important aspect of airspace management. Hildawati et al. (2024) and Aposporis (2024) highlighted developments in *Unmanned Aerial Vehicles* (UAVs) and their implications for regulation, whereas Kusumaningrum (2026) and Santoso et al. (2026) focused on interoperability and system integration (Shuliuk & Petrushka, 2024). This study



differs by connecting these various dimensions through a policy implementation perspective. Accordingly, airspace control is not understood as a sectoral issue but as a process requiring the integration of policy, organizations, technology, information, human resources, coordination, and *command and control*.

The theoretical contribution of this study lies in the contextual development of Mazmanian and Sabatier's policy implementation theory within the environment of national airspace control (Dubot & Joulia, 2023). The three groups of variables proposed in the theory remain relevant; however, the findings indicate that their application needs to be adapted to the characteristics of defense organizations and airspace management, which involve advanced technologies, strategic authority, interagency coordination, and the need for rapid decision-making. In this context, policy implementation cannot be adequately explained solely through the relationship between regulations and implementing actors. It must also take into account the capacity of organizations to integrate diverse resources, establish coordination, manage information, adapt to change, and generate effective operational responses.

This contribution broadens the perspective of policy implementation by incorporating the dimensions of interorganizational coordination, *collaborative governance*, and *command and control* (Westfall et al., 2023). This synthesis demonstrates that policy implementation in strategic environments requires organizational capacity capable of connecting normative and operational dimensions. Regulations serve as the foundation, institutions provide the framework for implementation, resources and technology support organizational capacity, while coordination and leadership function as mechanisms that connect all these components. Consequently, implementation is understood as a dynamic process influenced by the ability of a system to operate in an integrated manner, adapt to changing conditions, and respond to situations in a timely and appropriate way.

From a practical perspective, this study provides several implications for Koopsudnas and relevant stakeholders. First, the integration of policies, authority, organizational structures, technology, information, human resources, and coordination mechanisms needs to be strengthened to ensure that implementation is not hindered by institutional boundaries. Second, adaptive capacity should be enhanced through the modernization of surveillance and *command and control* technologies, improvements in personnel competencies, and adjustments to procedures in response to developments in aviation technology, including UAVs. Third, responsiveness should be strengthened throughout the entire operational chain, encompassing detection, identification, analysis, decision-making, coordination, action, and evaluation. Fourth, the distribution of authority and mechanisms for interagency coordination should be clarified to prevent overlapping responsibilities and delays in decision-making.

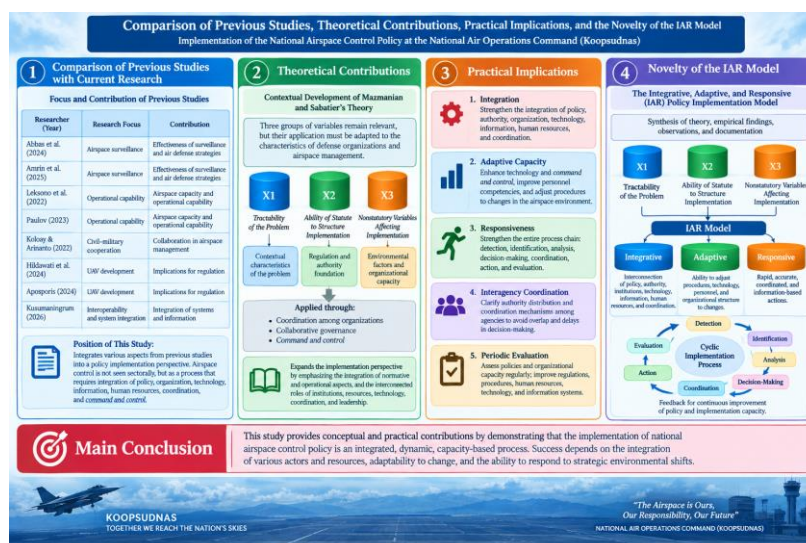
Another practical implication concerns the importance of periodically evaluating policies and organizational capacities. Changes in technology, patterns of airspace utilization, and evolving threats require organizations not merely to maintain existing procedures but to engage



in continuous learning and improvement (Levitt, 2025). Therefore, implementation evaluations should generate recommendations that can be translated into regulatory reforms, updates to operational procedures, improvements in personnel competencies, technological enhancements, and greater interoperability among information systems. Such an approach enables Koopsudnas to develop a more flexible airspace control capability that is responsive to changes in the strategic environment.

The novelty of this study lies in the development of the **Integrative, Adaptive, and Responsive (IAR) Policy Implementation Model**, which was specifically constructed based on empirical findings concerning the implementation of the national airspace control policy at Koopsudnas. This novelty is not intended to replace Mazmanian and Sabatier's theory but rather to provide a contextual development of the framework. Within the IAR Model, *Tractability of the Problem* is positioned as the contextual dimension representing the characteristics of the problem; *Ability of Statute to Structure Implementation* serves as the foundation for regulation and authority; while *Nonstatutory Variables Affecting Implementation* represents environmental factors and organizational capacity. These three elements are subsequently translated into three core capabilities: integrative, adaptive, and responsive.

Accordingly, the IAR Model offers a new perspective by demonstrating that the successful implementation of national airspace control policy cannot be assessed solely based on the existence of regulations or the technical capabilities of air defense. Success depends substantially on the capacity of the implementation system to integrate diverse actors and resources, adapt to changing conditions, and provide rapid and appropriate responses. The model is cyclical in nature because evaluation results serve as feedback for improving policies and implementation capacities in subsequent stages. Overall, this study makes both conceptual and practical contributions by positioning national airspace control policy implementation as an integrated, dynamic, capacity-based process oriented toward strengthening organizational capabilities to respond to changes in the strategic environment.





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## CONCLUSION

Based on the overall research process, it can be concluded that the implementation of the national airspace control policy at the National Air Operations Command (Koopsudnas) is a complex, multidimensional process involving various institutional components. Implementation is determined not only by the existence of regulations or the technical capabilities of air defense but also by the interaction between problem characteristics, the capacity of regulations to structure the implementation process, and environmental factors and organizational capacity. The *mixed-methods* approach, involving 233 respondents and 15 informants, provided both quantitative evidence and an in-depth understanding of the dynamics of policy implementation.

First, the findings demonstrate that the three variables within the Mazmanian and Sabatier framework *Tractability of the Problem* (X1), *Ability of Statute to Structure Implementation* (X2), and *Nonstatutory Variables Affecting Implementation* (X3) simultaneously have a significant effect on the implementation of the national airspace control policy. This is indicated by an F-value of 13.406 with a significance value of 0.000. These findings demonstrate that policy implementation results from the interaction of multiple factors, making it inappropriate to attribute the success of airspace control to a single aspect alone.

Second, the partial analysis revealed differences in the effects of the three variables. *Tractability of the Problem* had a significance value of 0.060 and therefore did not demonstrate a statistically significant effect at  $\alpha = 0.05$ . This finding indicates that the complexity of airspace-related problems does not independently determine the success of implementation. In contrast, *Ability of Statute to Structure Implementation* had a positive and significant effect, with a significance value of 0.005. This indicates that regulatory clarity, the distribution of authority, procedures, and implementation structures constitute important foundations for effective implementation.

Third, *Nonstatutory Variables Affecting Implementation* emerged as the most dominant factor. Variable X3 obtained a significance value of 0.000 and a Beta coefficient of 0.234, higher than X2 at 0.181 and X1 at 0.121. These findings indicate that the implementation environment, organizational capacity, human resources, technology, communication, leadership, institutional support, and interorganizational coordination occupy strategic positions in determining policy success. Therefore, well-designed regulations alone are insufficient without adequate organizational capacity and a supportive implementation environment.



Fourth, the explanatory capacity of the research model is reflected in an *Adjusted R Square* value of 0.138. Accordingly, the three research variables explain 13.8% of the variation in policy implementation, while the remaining 86.2% is influenced by other factors outside the model. This finding further reinforces the view that airspace control is a complex phenomenon influenced by various institutional, technological, resource-related, coordination, leadership, and strategic environmental factors.

Fifth, the study developed the Integrative, Adaptive, and Responsive (IAR) Policy Implementation Model as its principal contribution. The model integrates regulations, authority, institutional arrangements, technology, information, human resources, coordination, and *command-and-control* systems. The integrative dimension emphasizes the interconnectedness of all components; the adaptive dimension emphasizes the ability of organizations to adjust procedures, technology, competencies, and structures in response to change; while the responsive dimension emphasizes the capacity to produce rapid, accurate, and coordinated decisions and actions.

Sixth, the IAR Model is cyclical rather than linear. The process begins with detection, followed by identification, verification, analysis, decision-making, coordination, action, and evaluation. The results of the evaluation subsequently serve as feedback for improving policies, procedures, technology, organizational capacity, and human resource competencies. Thus, the study confirms that the success of national airspace control depends substantially on the ability of Koopsudnas and relevant stakeholders to establish an integrated implementation system capable of adapting to and responding rapidly to changes in the strategic environment.

Based on the research findings and the development of the IAR Model, the first recommendation is directed toward Koopsudnas to strengthen the integration of the policy implementation system. Integration should encompass policies, authority, organizational structures, human resources, technology, information systems, coordination, and *command-and-control* mechanisms. Airspace control should not be understood as the isolated responsibility of a single unit or institution but rather as a system connecting multiple actors according to their respective functions and authorities. Strengthening this integration is necessary to reduce potential delays in information flows, procedural differences, overlapping authority, and coordination barriers.

Second, the adaptive capacity of the organization needs to be strengthened. Changes in aviation technology, the development of UAVs, digital communication systems, surveillance sensors, and evolving threat dynamics require continuous improvements in organizational capabilities. Koopsudnas should regularly evaluate and adjust its operational procedures, personnel competencies, surveillance technologies, information systems, and *command-and-control* mechanisms. Adaptation does not merely involve acquiring new technologies but also ensuring that such technologies can be effectively integrated with human resources, procedures, organizational structures, and decision-making requirements. This recommendation is consistent with the finding that environmental factors and organizational capacity constitute the most dominant influences on implementation.



Third, a more measurable mechanism for responsiveness needs to be established. The entire airspace control process should be directed toward developing the capacity to respond rapidly and accurately, beginning with detection, identification, verification, and analysis, and continuing through decision-making, coordination, action, and evaluation. Each stage should have measurable performance indicators, such as the speed of information delivery, accuracy of identification, speed of decision-making, effectiveness of coordination, and quality of evaluation. Such indicators would enable the organization to identify which parts of the implementation chain continue to experience obstacles.

Fourth, the government and relevant stakeholders need to strengthen regulatory harmonization and the distribution of authority. The findings indicate that *Ability of Statute to Structure Implementation* has a positive and significant effect. Therefore, regulations need to be translated consistently into operational procedures that are easily understood and implemented by all relevant actors. Clarity regarding authority is also necessary to prevent overlapping responsibilities and delays in decision-making. In this context, cooperation among ministries, government agencies, the Indonesian National Armed Forces, air navigation service providers, and other relevant institutions should be strengthened through clear coordination mechanisms.

Fifth, human resource capacity needs to be strengthened as a central component of the IAR Model. Personnel competencies should be developed not only in technical areas but also in information management, interagency coordination, situational analysis, decision-making, technology utilization, and the ability to adapt to change. Training and competency development should be conducted periodically using scenarios that reflect the dynamic nature of airspace control.

Sixth, implementation evaluation should be conducted regularly and based on organizational learning. Evaluation should not end with the preparation of reports but should generate recommendations that can be translated into improvements in regulations, Standard Operating Procedures (SOPs), technology, organizational structures, personnel competencies, and coordination mechanisms. The IAR Model positions evaluation as a feedback mechanism that drives subsequent stages of the implementation process.

Seventh, future research is recommended to examine the IAR Model using broader methodological approaches, such as longitudinal studies, *big data analytics*, *system dynamics*, and *social network analysis*. These approaches may be used to measure changes in organizational capacity, coordination patterns, information integration, response speed, and adaptive capability over time. Comparative studies involving other countries may also provide valuable lessons and best practices in airspace control.

The principal recommendation of this study is that the implementation of the national airspace control policy should move beyond a purely regulatory and technical approach toward an integrative, adaptive, and responsive approach. The IAR Model can serve as a framework for strengthening implementation capacity by linking policy dimensions with organizational



capabilities for effective action. Through its application, the findings of this study are expected not only to contribute academically to the field of policy implementation but also to provide a foundation for the continuous improvement of national airspace control governance.

## REFERENCE

Alitz, E., Mulry, M. F., Hinman, S. J., & Kirkpatrick, K. M. (2025). Assessing the Feasibility of Implementing the Go for Green® Nutrition Program at the U.S. Air Force Air National Guard 109th Airlift Wing. In *Current Developments in Nutrition* (Vol. 9, hal. 106348). Elsevier BV. <https://doi.org/10.1016/j.cdnut.2025.106348>

Başbuğ, S., Zeki, R. Ç., Altay, M., & Taburoğlu, S. (2021). Automation and Test Software in Satellite Command and Control Systems: Procedure Executor. In *2021 15th Turkish National Software Engineering Symposium (UYMS)* (hal. 1–3). IEEE. <https://doi.org/10.1109/uym54260.2021.9659691>

Bazyliuk, A., & Nazarenko, I. (2024). Challenges And Opportunities For Implementing The E-Business Model Within The Framework Of Sustainable Development GOALS. In *Anti-Crisis Strategy for the Development of Socio-Economic Systems: Global Challenges*. Publishing House “Baltija Publishing.” <https://doi.org/10.30525/978-9934-26-500-6-10>

Berman, T. S., Barnett-Itzhaki, Z., Berman, T., & Marom, E. (2023). Antimicrobial resistance in food-producing animals: towards implementing a one health based national action plan in Israel. In *Israel Journal of Health Policy Research* (Vol. 12, Nomor 1). Springer Science and Business Media LLC. <https://doi.org/10.1186/s13584-023-00562-z>

Bjerke, H. M., & Valaker, S. (2022). Command and Control in a Fifth Generation Air Force: Coordination Requirements of Air Operations with F-35 and the Command and Control-System of the Norwegian Armed Forces. In *Scandinavian Journal of Military Studies* (Vol. 5, Nomor 1, hal. 14–30). Scandinavian Military Studies. <https://doi.org/10.31374/sjms.116>

Brewster, D. (2022). Beyond the National: Policy Negotiation, Resistance and Subversion. In *Cultures of Cannabis Control* (hal. 124–144). Policy Press. <https://doi.org/10.1332/policypress/9781529214963.003.0007>

Budiman, A. (2023). 1. Innovation: Robust Air Power Capable Of Continual Maritime Operations And Reinforced National Cyber Strategy To Protect National Security. In *TNI Angkatan Udara* (Vol. 2, Nomor 2). Tentara Nasional Indonesia Angkatan Udara. <https://doi.org/10.62828/jpb.v2i2.60>

Carvin, S. (2021). Canadian National Security Operations during COVID-19. In *Stress Tested* (hal. 107–126). University of Calgary Press. <https://doi.org/10.1515/9781773852454-008>

Demirbilek, B. (2022). Chapter 3: The Europeanisation of Turkish Water Policy: Implementing the Water Framework Directive at National Level. In *Europeanisation in Turkish Water Management Policy* (hal. 79–128). Lexington Books. <https://doi.org/10.5771/9781666901641-79>

Devi, P. (2024). Challenges and Prospects of Implementing the National Education Policy 2020 in Himachal Pradesh. In *Raj Rajeshwari Journal of Psychological and Educational Research* (hal. 72–77). Journalskart. <https://doi.org/10.65301/rjrp.2024.9.1.12>

Dubot, T., & Joulia, A. (2023). Correction: Mitigating Air Risk of Drone Operations in Low-



level Airspace with a 4D Trajectory U-space Framework. In *AIAA AVIATION 2023 Forum*. American Institute of Aeronautics and Astronautics. <https://doi.org/10.2514/6.2023-4109.c1>

Gavrillo, T., & Pobochenko, L. (2021). «Green» Banking As A Tool For Implementing The Model Of A Socially Responsible Banking Institution. In *Economics, management and administration in the coordinates of sustainable development*. Publishing House “Baltija Publishing.” <https://doi.org/10.30525/978-9934-26-157-2-24>

Gédrová, N., Džunda, M., & Melníková, L. (2024). Analysis of the airspace overload and performance of air traffic control over the Europe. In *2024 New Trends in Aviation Development (NTAD)* (hal. 45–49). IEEE. <https://doi.org/10.1109/ntad63796.2024.10850059>

Gnatyuk, V., Gorbachov, I., Golovan, M., & Batrak, O. (2024). Automation of Contact Center operations using a Chatbot. In *Projektowanie, badania i eksploatacja* (hal. 45–50). Wydawnictwo Naukowe Uniwersytetu Bielsko-Bialskiego. <https://doi.org/10.53052/9788367652261.05>

Gordienko, A. (2024). Certain Types Of Instruments Of The Administrative And Legal Mechanism For Ensuring Air Protection And Airspace Safety. In *Scientific works of National Aviation University. Series: Law Journal “Air and Space Law”* (Vol. 1, Nomor 70, hal. 9–15). National Aviation University. <https://doi.org/10.18372/2307-9061.70.18474>

Guía, P. V. (2024). Command in war: In *dianoesis* (Vol. 12, hal. 347–353). National Documentation Centre (EKT). <https://doi.org/10.12681/dia.37840>

Gussow, Z. (2021). Beginnings of a U.S. National Leprosarium. In *Leprosy, Racism, and Public Health* (hal. 130–148). Routledge. <https://doi.org/10.4324/9780429032783-10>

Halak, I., Dobrovolska, A., Dobrovolskiy, O., & Ovchar, D. (2024). Approaches To Implementing Sustainable Practices In The Operations Of Logistics Providers. In *Automobile Roads and Road Construction* (Nomor 116, hal. 278–297). National Transport University. <https://doi.org/10.33744/0365-8171-2024-116.2-278-297>

Haoyang, L., & Kharchenko, V. (2023). Air Traffic Control and Flight Planning for Cargo UAVS in a Single Airspace. In *Electronics and Control Systems* (Vol. 4, Nomor 78, hal. 78–83). State University “Kyiv Aviation Institute” <https://doi.org/10.18372/1990-5548.78.18280>

Hardwick, M., Kidan, N., Smith, N., & Manning, S. (2025). Air Quality Limit Values and Targets ???????? National-Level Commitment. In *Local Air Quality Control and Health* (hal. 77–84). Routledge. <https://doi.org/10.1201/9781003487449-10>

Hawley, J. (2021). *Concept for Multilevel Command-and-Control Performance Assessment in Air and Missile Defense Operations Centers*. DEVCOM Data and Analysis Center. <https://doi.org/10.21236/ad1154067>

Iwata, D., Nonaka, Y., & Itoh, E. (2025). Air traffic control method for more fuel efficient arrivals in terminal airspace. In *Journal of Air Transport Management* (Vol. 128, hal. 102799). Elsevier BV. <https://doi.org/10.1016/j.jairtraman.2025.102799>

Jackson, D. (2021). Command, Control and Communication. In *Human Spaceflight Operations: Lessons Learned from 60 Years in Space* (hal. 149–186). American Institute of Aeronautics and Astronautics, Inc. <https://doi.org/10.2514/5.9781624104770.0149.0186>

Jain, A., Idris, H. R., & Clarke, J.-P. (2025). Benefits of Traffic Following in High-Density Autonomous Airspace Operations. In *Journal of Air Transportation* (Vol. 33, Nomor 4, hal. 385–



391). American Institute of Aeronautics and Astronautics (AIAA).  
<https://doi.org/10.2514/1.d0486>

Jarvis, C., & Martin, K. M. (2024). A milestone in encryption control – what sank the US key-escrow policy? In *Intelligence and National Security* (Vol. 39, Nomor 6, hal. 986–1008). Informa UK Limited. <https://doi.org/10.1080/02684527.2024.2304933>

Jasper, F. N. H. (2024). A Estratégia Nacional de Defesa e o Sistema de Controle do Espaço Aéreo. In *Revista da UNIFA* (Vol. 22, Nomor 25). Universidade da Força Aérea. <https://doi.org/10.22480/rev.unifa.2009.22.841>

John, H. R., & John, W. K. (2022). Command and Control of U.S. Nuclear forces. In *Managing U.S. Nuclear Operations in the 21st Century* (hal. 167–200). The Brookings Institution. <https://doi.org/10.5040/9780815750727.ch-007>

Kalbani, A. al, Gultekin, H., & Hinai, N. Al. (2024). Challenges and Opportunities in Implementing a National Hazmat Management Framework in Oman. In *Proceedings of the International Conference on Industrial Engineering and Operations Management*. IEOM Society International. <https://doi.org/10.46254/gc02.20240081>

Kim, J., Liberko, N., & Atkins, E. (2022). Airspace Geofencing Volume Sizing with an Advanced Air Mobility Vehicle Performance Model. In *2022 IEEE/AIAA 41st Digital Avionics Systems Conference (DASC)* (hal. 1–8). IEEE. <https://doi.org/10.1109/dasc55683.2022.9925807>

Kosova, T., Ovsiuk, N., & Berezovskaya, E. (2021). Accounting And Analytical Support Of Operations With Non-Current Assets In The System Of Formation And Control Of Depreciation Policy Under. In *Market Infrastructure* (Nomor 60). Publishing House Helvetica (Publications). <https://doi.org/10.32843/infrastructure60-36>

Ledger, J. St. (2025). *Air Force Institute of Technology Dust Cloud Model Vertical Dispersion*. Office of Scientific and Technical Information (OSTI). <https://doi.org/10.2172/2570476>

Lei, X., & Zhou, L. (2024). *Can Command-and-Control Environmental Regulation Enhance Gtff?—Evidence from the Action Plan of Air Pollution Prevention and Control in China*. Elsevier BV. <https://doi.org/10.2139/ssrn.5018035>

Levitt, R. (2025). Creating Pollution Policy: The Control of Pollution Act 1974. In *Implementing Public Policy* (hal. 29–46). Routledge. <https://doi.org/10.4324/9781003647751-4>

Linh, T. N., (2024). A comprehensive study on reference material of Imidacloprid in tomato matrix. In *Heavy metals and arsenic concentrations in water, agricultural soil, and rice in Ngan Son district, Bac Kan province, Vietnam* (Vol. 7, Nomor 1, hal. 1–12). Vietnamese Journal of Food Control, National Institute for Food Control. <https://doi.org/10.47866/2615-9252/vjfc.4203>

Lipatov, I., Lavnichenko, O., & Hodlevskyi, S. (2023). Activities Of Military Command And Control And Moral And Psychological Support Structures To Maintain And Restore The Combat Capacity Of Formations (Military Units) Of The National Guard Of Ukraine. In *The scientific journal of the National Academy of National Guard “Honor and Law”* (Vol. 1, Nomor 84, hal. 97–101). National Academy of the National Guard of Ukraine. <https://doi.org/10.33405/2078-7480/2023/1/84/276852>

Litton, M. L., Drusinsky, D., & Michael, J. B. (2024). Assuring Reliability of Autonomous Commercial Drones in the National Airspace. In *2024 Annual Reliability and Maintainability Symposium (RAMS)* (hal. 1–6). IEEE. <https://doi.org/10.1109/rams51492.2024.10457690>



LIU, Z., CAI, K., & ZHU, Y. (2021). Civil unmanned aircraft system operation in national airspace: A survey from Air Navigation Service Provider perspective. In *Chinese Journal of Aeronautics* (Vol. 34, Nomor 3, hal. 200–224). Elsevier BV. <https://doi.org/10.1016/j.cja.2020.08.033>

Lucas, B. (2022). *Approaches to Implementing National Action Plans on Women, Peace and Security*. Institute of Development Studies. <https://doi.org/10.19088/k4d.2022.049>

Madhupriya, M. (2025). Challenges in Implementing National Education Policy 2020 in State Universities. In *International Journal For Multidisciplinary Research* (Vol. 7, Nomor 3). International Journal for Multidisciplinary Research (IJFMR). <https://doi.org/10.36948/ijfmr.2025.v07i03.44468>

Menon, P. K., & Iyer, H. N. (2024). Computational Approaches for Forecasting Operational Risks in the National Airspace System. In *AIAA SCITECH 2024 Forum*. American Institute of Aeronautics and Astronautics. <https://doi.org/10.2514/6.2024-2818>

Menzenski, J., Baumgartner, D. M., Cheng, J., Diffenderfer, P. A., Helleberg, J., Mykityshyn, A., & Wilkins, S. A. (2023). Airspace User-Air Traffic Control Information Exchange Using Mobile Devices to Enhance the Future Info-Centric National Airspace System. In *2023 IEEE/AIAA 42nd Digital Avionics Systems Conference (DASC)* (hal. 1–8). IEEE. <https://doi.org/10.1109/dasc58513.2023.10311312>

Mező, A. (2021). Command and Control of Multi-domain Operations. In *Hadtudomány* (Vol. 31, hal. 12–28). Hadtudomány. <https://doi.org/10.17047/hadtud.2021.31.e.12>

Neto, E. C. P., Baum, D. M., Almeida, J. R. de, Camargo, J. B., & Cugnasca, P. S. (2024). Building interfaces between unmanned aircraft systems (UAS), air traffic controllers (ATCo), and the national airspace system (NAS): A software training platform. In *Transportation Engineering* (Vol. 17, hal. 100266). Elsevier BV. <https://doi.org/10.1016/j.treng.2024.100266>

Notari, R. (2025). Autonomy Now?: Is It Time to Start Integrating (Autonomous) Urban Air Mobility Vehicles into the National Airspace System? In *Texas A&M Law Review Arguendo* (Vol. 12, Nomor 1, hal. 52–70). Texas A and M University School of Law. <https://doi.org/10.37419/lr.v12.arg.5>

Omotosh, O. (2025). *Operationalizing National Resilience: A Policy Framework for Implementing a U.S. Medical Operations Management Resilience Index Across Public and Private Healthcare Systems*; Elsevier BV. <https://doi.org/10.2139/ssrn.5951554>

Onduko, O. (2025). “President’s Chain Of Command And Shoot-To-Kill Orders: Between National Security And Human Rights Collapse.” Elsevier BV. <https://doi.org/10.2139/ssrn.5375348>

Pinti, A. (2024). Approaches to the mechanism of implementing the system of financial control of enterprises. In *Scientific Bulletin of Odessa National Economic University* (Vol. 12, Nomor 325, hal. 61–68). Scientific Bulletin of the Odessa National Economic University. <https://doi.org/10.32680/2409-9260-2024-12-325-61-68>

Pope, A. (2021). *Command Line Cheat Sheets [Slides]*. Office of Scientific and Technical Information (OSTI). <https://doi.org/10.2172/1785469>

Preda, V., Ghica, R., Blendea, I., Diacu, D., Ghiță, A., & Luchian, A.-M. (2024). Air Protection Encryption Protocols For Securing Air Traffic Control Communication. In *Review of the Air*



*Force Academy* (Vol. 22, Nomor 1, hal. 11–18). Henri Coanda Air Force Academy. <https://doi.org/10.19062/1842-9238.2024.22.1.2>

Rawal, P. B. (2023). Climate Change, Climatic Hazards and National Security of Nepal. In *Journal of APF Command and Staff College* (Vol. 6, Nomor 1, hal. 150–167). Nepal Journals Online (JOL). <https://doi.org/10.3126/japfcsc.v6i01.57592>

ROMAN, D. (2022). Considerations On The Design Of The Air Defence Response In The Current Airspace. In *Bulletin Of “Carol I” National Defence University* (Vol. 10, Nomor 4, hal. 44–51). Univeritatea Nationala de Aparare Carol I. <https://doi.org/10.53477/2284-9378-21-42>

Schimpf, N., Li, H., Knoblock, E., & Apaza, R. (2022). Communication Demand in the National Airspace – A Federated Learning Approach. In *2022 Integrated Communication, Navigation and Surveillance Conference (ICNS)* (hal. 1–11). IEEE. <https://doi.org/10.1109/icns54818.2022.9771527>

Shuliuk, B., & Petrushka, O. (2024). CORPORATE SOCIAL RESPONSIBILITY IN THE CONTEXT OF IMPLEMENTING THE PRIORITIES OF THE STATE FINANCIAL POLICY. In *Odesa National University Herald. Economy* (Vol. 29, Nomor 3). Publishing House Helvetica (Publications). <https://doi.org/10.32782/2304-0920/3-101-5>

Silva, K. D. D. (2021). An Analysis of the Role of Street-Level Bureaucrats in Implementing the National Labor Migration Policy in Sri Lanka. In *Policy Response, Local Service Delivery, and Governance in Bangladesh, Nepal, and Sri Lanka* (hal. 137–164). Springer International Publishing. [https://doi.org/10.1007/978-3-030-66018-5\\_6](https://doi.org/10.1007/978-3-030-66018-5_6)

Stasiev, Y., Nepokrytov, D., Parkhomenko, M., & Shylo, S. (2025). A Method For Protecting Space Communication And Control Systems Based On Dynamic Change Of Complex Signal Shapes. In *Kosmìčna nauka i tehnologiâ* (Vol. 31, Nomor 1, hal. 77–85). National Academy of Sciences of Ukraine (Co. LTD Ukrinformnauka) (Publications). <https://doi.org/10.15407/knit2025.01.077>

T, T., Muralidharan, H., & Kandasamy, P. (2021). Control of Brushless DC Motor by Voice Command Implementing Machine Learning. In *Materials Today: Proceedings* (Vol. 46, hal. 3841–3844). Elsevier BV. <https://doi.org/10.1016/j.matpr.2021.02.175>

Tebekin, A. V. (2022). Comprehensive analysis of the problems of implementing the financial policy of the state as an integral part of the problems of national economic policy. In *Теоретическая экономика* (Nomor 2, hal. 17–34). Yaroslavl State Technical University. [https://doi.org/10.52957/22213260\\_2022\\_2\\_17](https://doi.org/10.52957/22213260_2022_2_17)

Tupitsya, I. M., Ivashchuk, B. M., Volkov, Y. P., Parkhomenko, M. V, & Halepa, O. H. (2025). Algorithm for Forming a Computer Vision Model in the Interests of an Air Reconnaissance System. In *Visnyk of Vinnytsia Politechnical Institute* (Vol. 180, Nomor 3, hal. 140–146). Vinnytsia National Technical University. <https://doi.org/10.31649/1997-9266-2025-180-3-140-146>

Turchetti, J. V., & Murça, M. C. R. (2024). Analysis and Prediction of Airspace Availability for Urban Air Mobility Operations in the Sao Paulo Metropolitan Region. In *Transportes* (Vol. 32, Nomor 1). Associacao Nacional de Pesquisa e Ensino em Transportes. <https://doi.org/10.58922/transportes.v32i1.2896>

Umer, M., Rafique, Z., & Rashid, A. (2022). Challenges in Implementing the National Electric Vehicles Policy of Pakistan. In *SSRN Electronic Journal*. Elsevier BV.



Westfall, J., Carrozza, M., Rankin, J., & Jabbarpour, Y. (2023). Creating a National Scorecard on Primary Care – Implementing the NASEM Report. In *Economic or policy analysis* (hal. 3466). American Academy of Family Physicians. <https://doi.org/10.1370/afm.21.s1.3466>

Will, A., & Vance, S. M. (2022). Aviation Organization Strategy Development in National Airspace Modernization. In *International Journal of Aviation, Aeronautics, and Aerospace*. ERAU Hunt Library - DIGITAL COMMONS JOURNALS. <https://doi.org/10.15394/ijaaa.2022.1700>

Windhorst, R. D., Lauderdale, T. A., Cone, A., Fong, R. K., Palopo, K., Pham, D., & Phillips, J. (2024). Analysis of Hybrid Electric Aircraft Operations in the National Airspace System. In *AIAA AVIATION FORUM AND ASCEND 2024*. American Institute of Aeronautics and Astronautics. <https://doi.org/10.2514/6.2024-3958>

Yefimenko, L. I., Tykhanskyi, M. P., & Tykhanska, A. M. (2023). Adaptive control system with reference model of the boiler unit. In *Jornal of Kryvyi Rih National University* (Nomor 56, hal. 158–162). Kryvyi Rih National University. <https://doi.org/10.31721/2306-5451-2023-1-56-158-162>

ZALEVSKYI, A., & CHORNOGOR, N. (2021). Assessment of transport work in the performance of air transport operations. In *Scientific Bulletin of Flight Academy. Section: Economics, Management and Law* (Vol. 3, hal. 62–71). Flight Academy of National Aviation University. <https://doi.org/10.33251/2707-8620-2021-3-4-62-71>

Zeng, J. (2021). China's Artificial Intelligence Innovation: A Top-Down National Command Approach? In *Global Policy* (Vol. 12, Nomor 3, hal. 399–409). Wiley. <https://doi.org/10.1111/1758-5899.12914>

Zhao, C., Luo, J., Li, R., Gong, Y., & Wang, Y. (2024). A Simple Analysis of the Development Motivation of Penetrating Air Suppression Operations. In *Lecture Notes in Electrical Engineering* (hal. 311–316). Springer Nature Singapore. [https://doi.org/10.1007/978-981-99-9021-4\\_30](https://doi.org/10.1007/978-981-99-9021-4_30)