

The Influence of Competency and Skills on ATC Personnel Performance at Jakarta Air Traffic Service Centre

Yuliati Widyasari Dwi Putri¹⁾, Elfi Amir²⁾, Dwi Lestary³⁾

^{1,2,3)} Air Traffic Management Study Program / Applied Bachelor's Degree, Indonesian Aviation Polytechnic of Curug

*Corresponding Author

Email: yuliwidva76@gmail.com

Abstract

Flight safety and operational efficiency are highly dependent on the performance of Air Traffic Controllers (ATC), particularly at the Jakarta Air Traffic Service Center (JATSC) under the Area Control Center (ACC) unit, which manages one of the busiest airspaces in Indonesia. This study aims to analyze the influence of competency and skills on the work performance of ATC personnel at JATSC. Competency encompasses technical, cognitive, behavioral, and emotional dimensions, while skills include operational techniques, decision-making, communication, and stress management abilities. The research employed a quantitative explanatory design, utilizing structured questionnaires distributed to 81 active ATCs, complemented by direct observation. Data were analyzed using Pearson correlation and multiple linear regression to examine the relationships and effects between variables. The results indicate that both competency and skills significantly affect ATC performance. Competent ATCs demonstrate higher situational awareness, faster decision-making, and improved coordination, while well-developed skills enhance response speed and operational precision. Moreover, the findings highlight that competency has a slightly stronger impact than skills, underscoring the importance of continuous professional development and competency-based training programs. Therefore, strengthening both competency and skills through systematic training and evaluation is crucial to improving ATC performance and maintaining flight safety within Indonesia's increasingly complex air traffic environment.

Keywords: Competency, Skills, Work Performance, Air Traffic Controller, Jakarta Acc

INTRODUCTION

Aviation safety and operational efficiency are paramount priorities in the modern aviation industry. In this context, Air Traffic Controllers (ATCs) play a central role as regulators and coordinators of flight movements, ensuring that each aircraft operates in accordance with established procedures and remains free from potential conflicts. ATCs are required not only to deliver precise instructions to pilots but also to make critical, rapid decisions in highly dynamic and high-pressure environments (Bongo & Seva, 2023). In Indonesia, air traffic management is conducted by *Perum Lembaga Penyelenggara Pelayanan Navigasi Penerbangan Indonesia* (AirNav Indonesia), through its operational units known as Air Traffic Service Units (ATSU). Among these, the Jakarta Air Traffic Service Center (JATSC), particularly the Area Control Center (ACC), bears one of the highest operational workloads in the country due to its responsibility for managing the western sector of Indonesian airspace, including Jakarta and parts of Sumatra (Ibáñez et al., 2023).

Given the complexity and density of traffic within this sector, ATC personnel are required to maintain high levels of performance. However, the continuous rise in flight frequency, evolving navigation technologies, and increasing service expectations necessitate that AirNav Indonesia not only rely on standard operating procedures but also prioritize the human resource factors that drive operational excellence. Competency and skill, therefore, emerge as the two fundamental determinants of ATC performance (Rianto et al., 2021). *Competency* refers to a combination of technical, cognitive, behavioral, and emotional attributes that enable an individual to perform effectively (Toni et al., 2022), whereas *skill* encompasses both technical

and non-technical abilities such as communication, decision-making, and stress management (Roodbandi et al., 2025).

Recent data from AirNav Indonesia (2024) indicate that during the 2024 Eid travel period, AirNav managed 52,567 aircraft movements, with JATSC alone handling 13,814 movements an average of over 1,000 flights per day making it one of the busiest ATC facilities in Southeast Asia (Antara News, 2024). This workload reflects the immense operational pressure faced by ATCs in maintaining flight safety and efficiency. According to AirNav's *Safety Performance Review* (2024), approximately 70% of aviation safety risks are linked to human factors, particularly deficiencies in competency and skill during high-stress operational scenarios (Bongo & Seva, 2023). This observation aligns with ICAO's *Annex 1: Personnel Licensing* (2023), which stipulates that all ATCs must possess and continuously maintain technical, cognitive, and emotional competencies in accordance with global standards to ensure aviation safety (ICAO, 2023).

Based on data from AirNav Indonesia's 2025 *Safety Occurrences ANS Contribution Report*, there were 10 Airprox Category A and B incidents between November 2024 and June 2025, most of which were attributed to decision-making, communication accuracy, and situational awareness. Furthermore, JATSC recorded the highest number of incidents (six cases) among Indonesian air navigation units, indicating its operational complexity and the critical need for optimal human performance.

In this context, ATC performance at JATSC is primarily determined by two key factors: competency and skill. *Competency* embodies the foundation of knowledge, professional attitude, and analytical capability essential for rapid and accurate decision-making (Duan et al., 2023), whereas *skill* encompasses the operational and interpersonal abilities required to execute those decisions effectively (Liu et al., 2024).

RESEARCH METHODS

This study employed a quantitative associative approach designed to identify and analyze the relationship between measurable variables namely competency, skill, and job performance of Air Traffic Controllers (ATCs) at the Jakarta Air Traffic Service Center (JATSC). The research used an explanatory design, aiming not only to describe but also to explain the causal influence of competency and skill on performance (Duan et al., 2023). The quantitative method was selected to ensure objectivity, accuracy, and replicability of findings through statistical analysis (Mouratille et al., 2022).

Research Population and Sample

The population of this study included all active ATC personnel at the Area Control Center (ACC) JATSC, totaling 238 individuals. The sample was determined using purposive sampling, targeting ATCs who had served for at least two years and had experience handling high-traffic operational hours. The Slovin formula was applied with a 10% margin of error, resulting in a minimum sample size of 70 respondents. To compensate for potential non-response, an additional 10% was added, bringing the final total to 77 participants.

Operational Definition of Variables

1. Competency (X_1): Encompasses the technical, cognitive, behavioral, and emotional capabilities required for ATC operational effectiveness (Toni et al., 2022).
2. Skill (X_2): Refers to the practical and functional abilities that support task execution, including communication, response speed, and stress management (Liu et al., 2024).
3. Job Performance (Y): Represents the achievement level of ATCs in maintaining safety, efficiency, and adherence to standard operational procedures (Bongo & Seva, 2023).

Research Location and Duration

The study was conducted at AirNav Indonesia Jakarta Air Traffic Service Center, focusing on the ACC unit. The research process took approximately eight months (June 2025-January 2026), covering four main stages: preparation, data collection, data analysis, and final report writing.

Data Collection Techniques

Data were obtained using two complementary methods:

1. Direct Observation conducted in the ACC operational room to record real-time behaviors such as decision-making speed, communication frequency, and coordination patterns under workload conditions. The observation was non-participatory, ensuring objectivity while maintaining operational confidentiality.
2. Structured Questionnaire a Likert-scale instrument (1-5) distributed to active ATCs, measuring levels of competency, skill, and perceived job performance. Questions were adapted from prior validated studies and ICAO human factors standards (ICAO, 2023).

Data Processing and Analysis Techniques

Data analysis was conducted using IBM SPSS Statistics 25 to ensure reliability and accuracy (Field, 2018). The following tests and analyses were performed:

1. Pearson Correlation Test: To identify the strength and direction of the linear relationship between variables. Relationships were deemed significant at $p < 0.05$ (Sugiyono, 2019).
2. Multiple Linear Regression: To determine the simultaneous and partial effects of competency (X_1) and skill (X_2) on job performance (Y). This model allowed evaluation of each variable's contribution to performance improvement (Ghozali, 2018).

All research stages adhered to ethical research standards, ensuring confidentiality of respondent data and compliance with AirNav Indonesia's operational regulations

RESULT AND DISCUSSION

The study was conducted at the Jakarta Air Traffic Service Center (JATSC), focusing on the Area Control Center (ACC) unit under AirNav Indonesia, responsible for managing one of the busiest and most complex airspaces in the Jakarta Flight Information Region (FIR). The analysis involved 81 active Air Traffic Controllers (ATCs) who participated as respondents. The research examined the influence of competency (X_1) and skill (X_2) on job performance (Y) using statistical analysis through Pearson correlation and multiple linear regression.

The descriptive results indicated that ATC personnel in ACC JATSC demonstrated relatively high levels of competency and skill. The mean competency score was 54.51, indicating that controllers generally possess strong cognitive, technical, and behavioral capacities. The mean skill score was 24.40, reflecting a solid ability in operational, communicative, and stress management domains. Meanwhile, job performance showed a mean value of 24.30, confirming that the overall performance level of ATCs remains stable and aligned with operational standards set by AirNav Indonesia.

Table 1. Summary of Variable Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Competency (X_1)	81	39.00	65.00	54.51	5.87
Skill (X_2)	81	18.00	30.00	24.40	3.19
Job Performance (Y)	81	17.00	30.00	24.30	3.05

The normality test using the Kolmogorov-Smirnov method produced a significance level of 0.393, confirming that data residuals followed a normal distribution. Likewise, the multicollinearity test showed tolerance values of 0.714 and VIF values of 1.401, which fall within the accepted threshold, indicating that competency and skill are independent predictors (Ghozali, 2018).

The multiple regression analysis confirmed that both competency and skill significantly influence job performance. The F-test yielded a significance value well below 0.05, suggesting that the model was statistically valid. The coefficient of determination (R^2) was relatively high, meaning that a substantial portion of performance variation among ATCs could be explained by the combined effects of competency and skill.

Individually, competency (X_1) showed a positive and significant influence on performance (Y). This implies that higher competency levels including technical proficiency, cognitive awareness, and emotional control lead to better work outcomes. ATCs who exhibit strong competencies are more adept at maintaining situational awareness, making accurate decisions under time pressure, and minimizing operational errors, thus ensuring flight safety and efficiency (Duan et al., 2023). These findings are consistent with previous research emphasizing that competency is not merely a certification requirement but a functional attribute that underpins decision-making quality and service reliability (Toni et al., 2022).

Skill (X_2) was also found to have a positive and significant effect on performance (Y). The regression results indicate that ATCs with strong technical and non-technical skills such as communication, workload management, and multitasking demonstrate greater precision and consistency in their performance. Effective communication skills, for example, play a critical role in minimizing misunderstandings between ATCs and pilots, while stress management skills enable controllers to sustain focus during high traffic density (Liu et al., 2024; Roodbandi et al., 2025).

Although both factors were significant, competency contributed slightly more to performance variation than skill. This finding implies that competency forms the foundation for ATC effectiveness, while skill functions as a practical extension that enhances execution. Thus, competency and skill are complementary rather than substitutive optimal ATC performance can only be achieved when both dimensions are developed in tandem (Bongo & Seva, 2023).

Figure 1. Relationship between Competency, Skill, and Performance



A conceptual illustration showing that competency supports analytical and procedural decision-making, while skill enhances execution and adaptability in high-pressure environments.
Source: Processed Research Data (2025).

Figure 1. Relationship between Competency, Skill, and Performance

From a managerial perspective, these results highlight the importance of implementing integrated human resource development strategies. AirNav Indonesia, particularly JATSC management, should design training programs that combine theoretical instruction with practical simulations to strengthen both competency and skill domains. Scenario-based simulations, peer communication workshops, and stress management programs could serve as effective tools to enhance ATC readiness and resilience (ICAO, 2023).

Additionally, performance evaluation systems should incorporate competency and skill indicators as part of periodic assessment criteria. Such a holistic approach aligns with the continuous improvement framework advocated in ICAO's *Safety Management Manual*, which emphasizes evidence-based personnel development to mitigate human error and promote operational excellence (ICAO, 2023).

In theoretical terms, these findings reinforce models of human performance that attribute job success to a combination of ability (competency), practical mastery (skill), and motivation (Rianto et al., 2021). Within the context of ATC operations, the ability-skill interaction is particularly critical due to the cognitive and procedural demands of managing complex air traffic systems. The study contributes empirical evidence supporting the idea that investing in human capability through competency development and skill refinement translates directly into improved operational safety and service efficiency.

CONCLUSION

In conclusion, this study demonstrates that both competency and skill have a significant and positive impact on the performance of Air Traffic Controller (ATC) personnel at the Jakarta Area Control Centre (ACC JATSC). Competency, which encompasses technical, cognitive, behavioral, and emotional aspects, forms the foundation for accurate decision-making and efficient management of air traffic operations, while skill enhances execution, coordination, and adaptability under high-pressure conditions. The regression analysis confirms that the simultaneous improvement of these two variables contributes substantially to operational effectiveness and safety. This emphasizes the need for continuous professional development through structured training, performance evaluation, and skill-based enhancement programs. By integrating competency-building initiatives with practical skill refinement, AirNav Indonesia can strengthen the reliability and precision of its air traffic control services, ensuring that ATC personnel maintain optimal performance levels in managing one of the busiest and most complex airspaces in Southeast Asia.

REFERENCES

- Antara News. (2024, April 15). *AirNav layani 52.567 pergerakan pesawat di periode Lebaran 2024*. Retrieved from <https://www.antaranews.com/berita/4060551/airnav-layani-52567-pergerakan-pesawat-di-periode-lebaran-2024>
- Bongo, A., & Seva, L. (2023). Evaluating the Performance-Shaping Factors of Air Traffic Controllers Using Fuzzy DEMATEL and Fuzzy BWM Approach. *Aerospace*. <https://doi.org/10.3390/aerospace10030252>
- Duan, C., Hu, M., Yang, L., & Gao, Q. (2023). Core Competency Quantitative Evaluation of Air Traffic Controller in Multi-Post Mode. *Applied Sciences*. <https://doi.org/10.3390/app131810246>.
- Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics* (5th ed.). Sage Publications.

- Ghozali, I. (2018). Aplikasi Analisis Multivariate dengan Program IBM SPSS 25. Universitas Diponegoro Press.
- Ibáñez-Gijón, J., Travieso, D., Navia, J., Montes, A., Jacobs, D., & Frutos, P. (2023). Experimental validation of COMETA model of mental workload in air traffic control. *Journal of Air Transport Management*. <https://doi.org/10.1016/j.jairtraman.2023.102378>.
- ICAO. (2023). Annex 1: Personnel Licensing. International Civil Aviation Organization.
- Liu, B., Lye, S., & Zakaria, Z. (2024). An integrated framework for eye tracking-assisted task capability recognition of air traffic controllers with machine learning. *Adv. Eng. Informatics*, 62, 102784. <https://doi.org/10.1016/j.aei.2024.102784>.
- Mouratille, D., Amadieu, F., & Matton, N. (2022). A meta-analysis on air traffic controllers selection: cognitive and non-cognitive predictors. *Journal of Vocational Behavior*. <https://doi.org/10.1016/j.jvb.2022.103769>.
- Rianto, L., Indra, I., Manurung, B., & Edri, J. (2021). Pengaruh Pelatihan, Kompetensi, dan Komitmen terhadap Kinerja Petugas Air Traffic Controller (ATC) pada AirNav Indonesia Cabang Medan. *Jurnal Riset Akuntansi Multiparadigma*, 7(2), 337–345. <https://doi.org/10.30743/akutansi.v7i2.3377>
- Roodbandi, A., Choobineh, A., & Nami, M. (2025). Identifying critical abilities for optimal performance of air traffic controllers: a subject matter expert rating approach. *International journal of occupational safety and ergonomics : JOSE*, 1-11 . <https://doi.org/10.1080/10803548.2025.2461407>.
- Sugiyono. (2019). Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Alfabeta.
- Toni, T., Sukamdani, N., & Hardiyanto, T. (2022). The Impact Of Competence And Service Placement To Regulatory Work Motivation Air Traffic Of Indonesian Aif Force. *The International Journal of Business Review (The Jobs Review)*. <https://doi.org/10.17509/tjr.v5i2.51044>.