

Airport Resilience Under Exceptional Demand: A System-of-Systems and Systems Engineering Assessment at Djalaluddin Gorontalo Airport

Sri Susanty Satya A. Dukalang ^{1✉}, Kusnadi ²

(1) Civil Engineering, Universitas Muhammadiyah Gorontalo, Gorontalo, Indonesia

(2) Civil Engineering, Universitas Khairun Ternate, Ternate, Indonesia

Abstract: Airports must maintain operational continuity while responding to changing demand and environmental conditions. This study assesses the operational readiness and resilience context of Djalaluddin Gorontalo Airport following infrastructure expansion by examining the interaction between exceptional aircraft demand, operational complexity, and historical weather exposure. A transportation system-of-systems perspective was applied using descriptive statistics, sample standard deviation, Z-score standardization, circular analysis of wind direction, and a Demand Amplification Ratio (DAR). The empirical assessment focused on 16 private/VIP aircraft movements during PENAS XVII 2026, comprising eight arrivals and eight departures, and historical weather conditions during June 2021–2025. The results show a DAR of 1.78, indicating that the recorded private/VIP aircraft activity was 1.78 times the routine scheduled-operation baseline used for the three-day comparison. The movements also extended across a longer operating period and involved diverse aircraft types, indicating increased operational complexity. Historical weather analysis showed that rainfall had the greatest variability, while relative humidity and wind speed were comparatively consistent, with no exceptionally anomalous June observation identified through Z-score analysis. The findings indicate that airport resilience should consider not only disruption and recovery but also the ability to adapt to exceptional operational demand under environmental variability. The study provides an evidence-based basis for strengthening operational readiness planning at regional airports.

Article history:

Received: 11 September 2026

Revised: 02 October 2026

Accepted: 06 October 2026

Published: 10 October 2026

Keyword:

airport resilience, systems engineering, system-of-systems, air transportation systems, airport operations

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How to cite: Dukalang, S. S. S. A., & Kusnadi, K. (2026). Airport Resilience Under Exceptional Demand: A System-of-Systems and Systems Engineering Assessment at Djalaluddin Gorontalo Airport. *RESWARA: Jurnal Riset Ilmu Teknik*, 4(4), 1528–1540. <https://doi.org/10.70716/reswara.v4i4.877>

INTRODUCTION

Airport resilience has become increasingly important because aviation operations are influenced by environmental factors, including rainfall, wind, flooding, and other weather-related events. The International Civil Aviation Organization (ICAO) emphasizes the need to consider climate risks and resilience in airport planning, development, operations, and maintenance (ICAO, 2022). Zhou and Chen (2020), Huang et al. (2021), and Poo et al. (2021) have proposed approaches for assessing airport resilience through recovery performance, multi-criteria assessment, and indicators of exposure, vulnerability, and adaptive capacity. However, much of the existing research has focused on explicit disruptions, particularly severe weather and other disruptive events. Conditions in which an airport experiences an exceptional increase in aircraft activity without necessarily experiencing infrastructure failure or a disaster have received comparatively limited attention in airport resilience assessment.

Exceptional aircraft demand can serve as an observational operational stress-test because it requires an airport system to operate beyond its routine pattern. An increase in aircraft movements, extended operating hours, greater diversity in aircraft characteristics, and additional coordination

requirements may increase the complexity of interactions among demand, infrastructure, and operations. This condition is particularly relevant to regional airports with relatively low routine flight volumes that may periodically be required to accommodate substantially higher operational demands. Therefore, airport resilience should not be assessed solely in terms of the ability to withstand disruptions, but also in terms of the system's ability to adapt to changes in operational demand under varying environmental conditions.

Djalaluddin Gorontalo Airport provides a relevant context for examining this condition. As a regional airport with relatively low routine commercial flight activity, the airport has experienced changes in its operational context alongside infrastructure development. In February 2026, infrastructure development at Djalaluddin Gorontalo Airport was officially launched by the Governor of Gorontalo through the inauguration of development works, including apron expansion and taxiway construction to support the airport's development as a Hajj embarkation airport and to anticipate future aviation demand. Airport infrastructure and planning considerations provide an important foundation for understanding the relationship between airport facilities, operational requirements, and future development needs (Dukalang, 2026a, 2026d). Previous studies by the author have examined runway ACN-PCN compatibility (Dukalang, 2025), night-flight readiness (Dukalang, 2026b), and operational resilience of airside capacity during infrastructure development (Dukalang, 2026c). The present study extends this research trajectory by moving from infrastructure and capacity toward airport resilience as a transportation system-of-systems.

An empirical case was observed during PENAS XVII 2026 on 22–24 June 2026, when Djalaluddin Gorontalo Airport accommodated 16 private/VIP aircraft movements, consisting of eight arrivals and eight departures. This activity differed from the routine commercial operating pattern and is treated as an operational stress-test to examine changes in operational intensity, operating time, and aircraft diversity. This study aims to assess the airport resilience context by integrating flight demand, operational complexity, and historical weather exposure within a transportation system-of-systems perspective. The analysis employs descriptive statistics, sample standard deviation, Z-score standardization, circular analysis of wind direction, and the Demand Amplification Ratio (DAR). The novelty of this study lies in using an actual exceptional-demand event as an observational stress-test to extend airport resilience assessment beyond a focus on disruptions toward the system's ability to adapt to changes in operational demand, particularly at regional airports undergoing infrastructure development.

RESEARCH METHOD

This study employs a quantitative retrospective case-study approach to assess airport resilience under exceptional transportation demand using a System-of-Systems (SoS) and systems engineering perspective. The analysis integrates historical meteorological observations, airport operational characteristics, infrastructure capacity, passenger and aircraft movements, and the exceptional-demand condition associated with PENAS XVII 2026. The retrospective design establishes a normal operational baseline and subsequently examines how the airport transportation system performs when demand and operating conditions deviate substantially from routine conditions. The airport is treated as an interconnected transportation SoS in which infrastructure, aircraft operations, passenger movement, terminal facilities, airside capacity, and supporting operational functions interact to

maintain overall system functionality. This approach is consistent with airport systems and capacity planning principles (Ashford, Mumayiz, & Wright, 2011; de Neufville & Odoni, 2003) and with transportation resilience research emphasizing system interdependencies (Miller-Hooks et al.; Mostafavi, 2017; Tang et al., 2020; Axelsson et al., 2026). The analysis therefore considers how changes in one component may influence the operational conditions of other interconnected components. The interaction between demand, infrastructure, environmental exposure, and supporting functions is examined as part of the overall airport system. This perspective is particularly relevant when exceptional demand occurs within an airport system that normally operates under relatively low traffic volumes. Accordingly, the assessment focuses on the relationships among system components rather than evaluating individual airport elements in isolation.

The study was conducted at Djalaluddin Gorontalo Airport, Gorontalo, Indonesia, a regional airport with relatively low routine commercial flight activity. Under normal conditions, the airport operates approximately three scheduled passenger flights per day. The airport provides an appropriate case for resilience assessment because its routine demand is relatively low, while its infrastructure has undergone expansion and its strategic role has increased. PENAS XVII 2026 generated an exceptional transportation demand involving aircraft movements, passenger movements, and supporting airport activities that differed from the airport's normal operating pattern. The event was therefore treated as a natural stress-test condition rather than as a conventional disaster. The stress-test perspective enables the study to examine how the airport system responds to an observed increase in operational intensity without assuming the occurrence of infrastructure failure. It also provides an opportunity to identify changes in temporal activity, aircraft diversity, and coordination requirements associated with exceptional demand. These characteristics allow the resilience context of the airport to be examined under conditions that differ from its routine operating environment. Previous airport-specific studies on runway ACN-PCN compatibility, night-flight readiness, and airside operational resilience provide supporting evidence for interpreting the airport's infrastructure and operational characteristics (Dukalang, 2025, 2026a, 2026b), while airport planning and capacity principles are supported by Ashford, Mumayiz, and Wright (2011) and de Neufville and Odoni (2003). This case therefore enables the comparison of routine operating conditions with an observed period of unusually high and complex transportation activity.

The system boundary included the principal airport transportation components that contribute to operational continuity, namely the runway, taxiway, apron, terminal facilities, aircraft operations, passenger movement, and supporting operational functions. The study used secondary quantitative data obtained from the Meteorology, Climatology, and Geophysical Agency (BMKG) and airport-related operational sources. The meteorological dataset consisted of monthly June observations for 2021–2025, including rainfall (mm), relative humidity (%), average wind speed (knots), and maximum-wind direction (degrees). These data were used to establish the five-year historical environmental baseline and to calculate the mean, sample standard deviation, and standardized Z-scores. Operational data for PENAS XVII 2026 covered aircraft movement dates, arrival and departure times, aircraft types, and the total number of private/VIP movements recorded during 22–24 June 2026. Airport infrastructure and operational characteristics were obtained from available airport-related technical and operational information. Missing observations were retained as missing values and were not statistically imputed.

The analytical framework consists of interconnected dimensions representing exceptional demand, infrastructure capacity, operational performance, weather exposure, and system resilience. Exceptional demand represents the deviation of aircraft and passenger movements from the normal operational baseline. Infrastructure capacity represents the ability of the runway, taxiway, apron, and terminal facilities to accommodate transportation demand. Operational performance represents available indicators of service continuity, utilization, and operational conditions. Weather exposure represents environmental conditions that may influence airport operations, including rainfall, relative humidity, wind speed, and wind direction. These dimensions are assessed as interacting elements of the airport SoS rather than as independent variables. This perspective is consistent with the system-of-systems approach to resilient transportation infrastructure proposed by Miller-Hooks et al. and Mostafavi (2017), and with airport infrastructure resilience and adaptation frameworks developed by Poo et al. (2021) and Comes et al. (2020). Figure 1 summarizes the analytical structure of the study, linking exceptional demand and weather exposure to the interconnected airport transportation system, operational performance, and the subsequent resilience assessment.

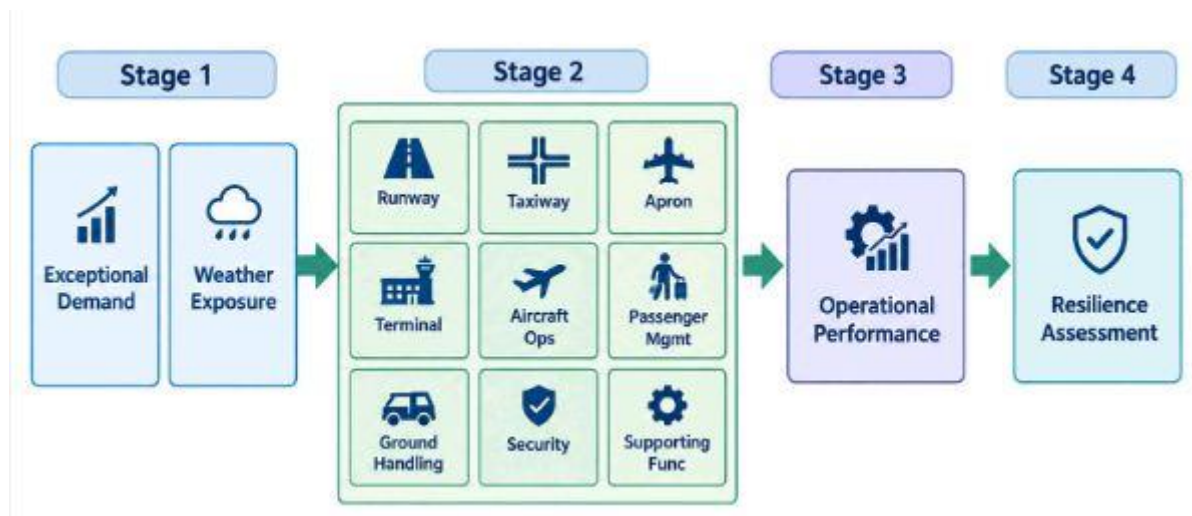


Figure 1. Airport Transportation System-of-Systems Resilience Framework for Djalaluddin Gorontalo Airport.

Before analysis, all available data were checked for completeness, consistency, chronological organization, measurement units, and potential recording errors. Missing observations were identified and retained as missing when reliable information was unavailable rather than being estimated through statistical imputation. Wind-speed observations reported in knots were converted into metres per second for analytical consistency using:

$$V(\text{m/s}) = 0.514444 \times V(\text{knots}) \quad (1)$$

where V represents wind speed. Descriptive statistics were then used to characterize the historical distribution and variability of the meteorological variables. The arithmetic mean was calculated as:

$$\bar{X} = \frac{\sum X_i}{n} \quad (2)$$

where $\bar{X}$ is the mean value, X_i is the observed value, and n is the number of observations.

The standard deviation was calculated as:

$$SD = \sqrt{[\sum(X_i - \bar{X})^2 / (n - 1)]} \quad (3)$$

where SD is the standard deviation. The October 2024 wind-speed observation was confirmed with BMKG as 13 knots, while unavailable November and December 2025 observations were retained as missing values. This data-validation procedure was applied to minimize the influence of recording errors and incomplete observations on the subsequent statistical analysis.

The standardized Z-score was calculated to determine the relative deviation of each annual meteorological observation from the five-year June mean:

$$Z_i = \frac{(X_i - \bar{X})}{SD} \quad (4)$$

where (Z_i) is the standardized Z-score for observation (i), (X_i) is the observed value, $\bar{X}$ is the arithmetic mean of the variable for June 2021–2025, and (SD) is the sample standard deviation calculated from the same five-year dataset. Positive Z-scores indicate values above the five-year mean, whereas negative Z-scores indicate values below the mean. A value of $Z=0$ represents the five-year mean. For each meteorological variable, the Z-score was calculated separately for each year using the five June observations from 2021 to 2025. The same five-year mean and sample standard deviation were applied consistently within each variable. For example, the rainfall Z-score for 2022 was calculated using the 2022 June rainfall value of 180 mm, the five-year June rainfall mean of 133.2 mm, and the sample standard deviation of 78.08 mm, resulting in a Z-score of approximately 0.60. The same procedure was applied to relative humidity and wind speed.

For comparative analysis, indicators with different units and numerical ranges were normalized using the min–max normalization method:

$$I_j = \frac{(X_j - X_{j,\min})}{(X_{j,\max} - X_{j,\min})} \quad (5)$$

where I_j is the normalized indicator, X_j is the observed value, $X_{j,\min}$ is the minimum value, and $X_{j,\max}$ is the maximum value. Normalization was applied to place the selected indicators on a comparable scale before their interpretation within the resilience assessment. For indicators in which higher values represent greater disruption or vulnerability, the direction was reversed before aggregation so that higher normalized values consistently represented better resilience performance. Wind direction was treated separately because it is a circular variable and cannot appropriately be analyzed using an ordinary arithmetic mean. Directional observations were therefore transformed into sine and cosine components:

$$C = \frac{\sum \cos(\theta_i)}{n} \quad (6)$$

$$S = \frac{\sum \sin(\theta_i)}{n} \quad (7)$$

and the representative mean wind direction was obtained as:

$$\bar{\theta} = \text{atan2}(S, C) \quad (8)$$

This procedure avoids the misleading results that may occur when directional values near 0° and 360° are averaged arithmetically, and allows wind direction to be interpreted in relation to runway orientation (Borsky & Unterberger, 2019; de Oliveira et al., 2021; Song et al., 2024). This treatment is particularly relevant for the 09/27 runway orientation because the prevailing directional pattern can be interpreted in relation to the runway alignment and potential crosswind exposure. Exceptional demand was assessed by comparing PENAS XVII 2026 conditions with the established normal operational baseline. The normal operational baseline was established from the scheduled commercial flight pattern at Djalaluddin Gorontalo Airport. The airport operated approximately three scheduled aircraft movements per day, based on the scheduled operations of Batik Air, Garuda Indonesia, and Lion Air. This rate was used as the baseline because the PENAS XVII 2026 event was assessed over the same three-day period. The exceptional-demand dataset consisted of 16 recorded private/VIP aircraft movements during 22–24 June 2026, comprising eight arrivals and eight departures. The Demand Amplification Ratio (DAR) was calculated as:

$$\text{DAR} = \frac{\text{Devent}}{\text{Dbaseline}} \quad (9)$$

Where Devent represents observed demand during PENAS XVII 2026 and Dbaseline represents corresponding demand under normal operating conditions. The use of a corresponding normal baseline provides a consistent reference for quantifying the extent to which exceptional event demand deviated from routine airport operations. Aircraft movement demand and passenger demand were evaluated separately when reliable data were available. A DAR greater than 1 indicates that demand during the event exceeded the normal baseline, while a larger ratio indicates a stronger deviation from routine operating conditions. For the three-day PENAS XVII 2026 event, event demand (Devent) was defined as the total recorded private/VIP aircraft movements during 22–24 June 2026. The corresponding baseline demand (Dbaseline) was defined as the routine scheduled aircraft movement rate multiplied by the same three-day observation period. Thus, the baseline was calculated as $\text{Dbaseline} = 3 \times 3 = 9$ movements, while the observed event demand was $\text{Devent} = 16$ private/VIP movements. The resulting DAR was therefore $16/9 = 1.78$. This calculation provides a transparent comparison between the observed exceptional-demand activity and the airport's routine scheduled-operation baseline.

The resulting demand amplification was examined together with infrastructure capacity and operational performance to determine whether the airport maintained its transportation functionality under exceptional demand. This approach is consistent with resilience assessment frameworks emphasizing adaptation and rapid response under changing operational conditions (Comes et al., 2020; Poo et al., 2021). The overall resilience assessment was based on the interaction between normalized indicators representing demand, capacity, operational performance, weather exposure, and system capability. Where sufficient empirical indicators were available, a composite Resilience Index (RI) was calculated as:

$$\text{RI} = \sum(w_j \times I_j) \quad (10)$$

where RI is the resilience index, w_j is the weight assigned to indicator j , and l_j is the normalized value of indicator j .

The weights satisfy :

$$\sum w_j = 1 \quad (11)$$

When sufficient empirical evidence was not available to justify differential weighting, equal weights were applied to avoid introducing subjective preferences. This weighting approach ensures that no individual indicator is given disproportionate influence on the overall resilience assessment in the absence of sufficient empirical justification. The RI was interpreted comparatively rather than as an absolute probability of system failure. A higher RI indicates stronger overall system performance across the selected indicators, whereas a lower RI indicates greater exposure to disruption or reduced system capability. The assessment therefore focuses on the airport's ability to maintain functionality when demand and operating conditions change, consistent with system-level transportation resilience concepts (Miller-Hooks et al.; Mostafavi, 2017; Comes et al., 2020; Axelsson et al., 2026).

The analysis followed a sequential process consisting of data collection and validation, establishment of the normal operational baseline, descriptive statistical analysis, weather exposure assessment, transportation SoS mapping, exceptional-demand assessment, demand–capacity–performance comparison, indicator normalization, resilience-indicator assessment, and identification of critical subsystems and resilience conditions. The final interpretation considers the airport as an interconnected transportation system rather than a collection of independent facilities, while recognizing that the available data limit the assessment to observable and supportable resilience indicators. Accordingly, the framework provides a reproducible, quantitative, and data-proportionate systems engineering approach for evaluating how Djalaluddin Gorontalo Airport responds when transportation demand exceeds its normal operating pattern.

RESULTS AND DISCUSSION

The operational context of Djalaluddin Gorontalo Airport provides an important baseline for assessing resilience under exceptional demand. During normal operations, the airport handles approximately three scheduled commercial aircraft movements per day, primarily concentrated in the morning and afternoon. The airport operates as a system-of-systems (SoS), in which runway, taxiway, apron, terminal, aircraft, passengers, ground handling, security, and supporting operational functions interact to maintain continuity of service. From this perspective, resilience cannot be assessed solely from the performance of an individual infrastructure component but should consider the interaction among system components and the airport's ability to accommodate temporary increases in operational complexity. The PENAS XVII 2026 event therefore provides an empirical case for assessing airport resilience under exceptional demand by examining the associated operational conditions and system interactions. This baseline establishes a reference against which the magnitude and operational implications of the exceptional aircraft activity can be evaluated.

During PENAS XVII 2026, a total of 16 private/VIP aircraft movements were recorded, consisting of 8 arrivals and 8 departures. The daily distribution was 2 movements on 22 June, 6 movements on 23 June, and 8 movements on 24 June 2026. Thus, the final day accounted for 50% of all recorded private/VIP movements during the three-day event. To compare this exceptional activity

with the airport's routine operating pattern, the three-day baseline was estimated from the normal rate of three scheduled operations per day:

$$D_{\text{baseline}} = 3 \times 3 = 9$$

The total event demand was:

$$D_{\text{event}} = 16$$

Accordingly, the Demand Amplification Ratio (DAR) was calculated as:

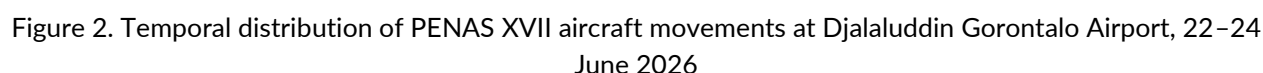
$$\text{DAR} = \frac{D_{\text{event}}}{D_{\text{baseline}}} = \frac{16}{9} = 1.78$$

The DAR of 1.78 indicates that the recorded private/VIP aircraft activity was 1.78 times the estimated routine scheduled-operation baseline over the same three-day period. This value should not be interpreted as a 78% increase in total airport traffic because the numerator represents exceptional private/VIP movements whereas the denominator represents routine scheduled commercial operations. Instead, DAR is used as a comparative indicator of the magnitude of exceptional aircraft activity relative to the airport's low-volume routine operating pattern. The result indicates that a relatively small absolute number of additional movements can represent a substantial change in operational demand for a low-frequency airport.

Table 1. Distribution of Private/VIP Aircraft Movements during PENAS XVII 2026

Date	Arrival (ETA)	Departure (ETD)	Total Movements
22 June 2026	22:15	21:30	2
23 June 2026	13:00, 13:00, 19:00 21:30	13:30, 19:30	6
24 June 2026	07:30, 13:30, 17:30	10:00, 11:00, 16:00 17:00, 18:00	8
Total	8	8	16

The temporal distribution of the movements further demonstrates the operational complexity generated by the event. The recorded private/VIP activity at Djalaluddin Gorontalo Airport occurred between 07:30 and 22:15. On 22 June, one arrival was recorded at 22:15 and one departure at 21:30. Activity increased on 23 June, with four arrivals at 13:00, 13:00, 19:00, and 21:30, and two departures at 13:30 and 19:30. The highest daily activity occurred on 24 June, with three arrivals at 07:30, 13:30, and 17:30 and five departures at 10:00, 11:00, 16:00, 17:00, and 18:00. Thus, the event extended aircraft activity across an approximately 14-hour-45-minute period and included both daytime and evening operations. In a SoS perspective, this temporal extension may increase coordination requirements among airside operations, ground handling, security, passenger services, lighting, and other supporting functions. The temporal distribution of these movements is illustrated in Figure 2, which highlights the concentration of aircraft activity across daytime and evening operating periods.



The event also involved heterogeneous aircraft types, including Beechjet 400, H25B, C700, Boeing 737NG, Gulfstream IV, G451, and G450. This diversity is relevant because exceptional demand cannot be represented only by the number of movements. Different aircraft types may impose different requirements in terms of parking positions, ground handling, passenger processing, turnaround activities, and airside coordination. The coexistence of business jets and larger aircraft such as the Boeing 737NG therefore illustrates the multidimensional nature of exceptional demand. These characteristics support the application of a systems-engineering and system-of-systems (SoS) perspective in which demand intensity, temporal distribution, aircraft heterogeneity, and supporting-system requirements are considered together.

Historical June meteorological conditions were examined to establish the environmental context surrounding airport operations. Rainfall during June 2021–2025 ranged from 49 mm in 2021 to 225 mm in 2024, with a mean of 133.2 mm and a standard deviation of 78.08 mm. Relative humidity ranged from 83% to 85%, with a mean of 83.8% and a standard deviation of 1.10 percentage points. Average wind speed ranged from 14 to 18 knots, equivalent to approximately 7.20–9.26 m/s, with a mean of 16.0 knots (8.23 m/s) and a standard deviation of 2.00 knots (1.03 m/s). Among the examined variables, rainfall exhibited the greatest interannual variability, whereas relative humidity and wind speed were comparatively stable.

Table 2. Historical Meteorological Conditions in June at Djalaluddin Gorontalo Airport, 2021–2025

Year	Rainfall (mm)	Relative Humidity (%)	Average Wind Speed (knots)	Average Wind Speed (m/s)	Wind Direction (°)
2021	49	83	14	7.20	180
2022	180	85	18	9.26	180
2023	55	83	14	7.20	180
2024	225	85	16	8.23	180
2025	157	83	18	9.26	180
Mean	133.2	83.8	16.0	8.23	180
SD	78.08	1.10	2.00	1.03	—

To assess whether the observed June conditions were unusually anomalous, standardized Z-scores were examined. Rainfall produced Z-scores of 0.60 in 2022, 1.18 in 2024 and 0.30 in 2025, while 2021 and 2023 produced -1.08 and -1.00 , respectively. Relative humidity reached 1.10 in 2022 and 2024, while the remaining years were approximately -0.73 . Wind speed reached 1.00 in 2022 and 2025, and -1.00 in 2021 and 2023, with 2024 recording a Z-score of 0.00. None of the examined observations exceeded ± 2 standard deviations. Thus, the historical June observations do not indicate an exceptionally anomalous meteorological condition based solely on the applied Z-score criterion. The weather data consequently provide an environmental baseline rather than direct evidence that the PENAS event was disrupted by extreme weather.

Table 3. Z-Scores of June Meteorological Variables, 2021–2025

Year	Rainfall Z-score	Relative Humidity Z-score	Wind Speed Z-score
2021	-1.08	-0.73	-1.00
2022	0.60	1.10	1.00
2023	-1.00	-0.73	-1.00
2024	1.18	1.10	0.00
2025	0.30	-0.73	1.00

Wind direction was additionally evaluated using a circular approach because directional data cannot appropriately be treated as ordinary linear measurements. The recorded June maximum-wind direction was 180° for each year from 2021 to 2025. Using the circular representation.

$$C = \frac{\sum \cos(\theta_i)}{n} \text{ and } S = \frac{\sum \sin(\theta_i)}{n} \text{ and } \theta = \text{atan2}(S, C)$$

The resulting mean direction was 180° . The consistency of the recorded direction indicates no meaningful interannual variation in the June maximum-wind direction within the available dataset. This result should be interpreted as a characteristic of the recorded monthly observations and should not be taken to mean that wind direction remained constant during every individual day or aircraft movement.

Taken together, the PENAS event illustrates the multidimensional factors that should be considered when assessing airport resilience under exceptional demand. The airport accommodated 16 private/VIP movements over three days, corresponding to a DAR of 1.78 relative to the routine scheduled-operation baseline, with movements distributed between 07:30 and 22:15 and involving several aircraft types. At the same time, the historical June weather data show substantial rainfall variability but no Z-score evidence of exceptionally anomalous conditions. The findings therefore

support a data-proportionate interpretation in which operational resilience depends on the interaction among exceptional demand, temporal complexity, aircraft heterogeneity, infrastructure capacity, environmental exposure, and supporting airport functions.

A numerical composite Resilience Index (RI) was not calculated because detailed and sufficiently consistent data on runway capacity, apron utilization, terminal utilization, aircraft turnaround performance, delays, and other operational-performance indicators were not available for the event period. Although the conceptual formulation,

$$RI = \sum(w_j \times I_j) \text{ and } \sum w_j = 1$$

provides a framework for future quantitative aggregation, applying it with incomplete capacity and performance data would introduce unsupported assumptions. The present findings therefore use a comparative and data-proportionate resilience assessment rather than an artificially precise composite score. Within this limitation, the PENAS XVII 2026 event provides an empirical case showing how a low-volume airport may experience substantial increases in operational complexity under exceptional demand.

CONCLUSION

This study indicates that resilience assessment at Djalaluddin Gorontalo Airport should consider the interaction among environmental conditions, flight demand characteristics, and operational complexity within a transportation system-of-systems framework. Based on the assessment of normal operating conditions, private/VIP aircraft movements during PENAS XVII 2026, temporal distribution and aircraft diversity, and historical weather characteristics during June 2021–2025, the event provides an observational stress-test of exceptional demand conditions that differed from the airport's routine flight pattern. The Demand Amplification Ratio (DAR) was 1.78 times the routine scheduled-operation baseline used for the three-day comparison. Furthermore, the extended operating period into the evening and the diversity of aircraft types indicate increased operational complexity that should be considered in airport resilience and operational readiness planning. The weather assessment shows that rainfall exhibited the greatest historical variability, whereas relative humidity and wind speed were comparatively consistent during the analyzed period; however, the standardized Z-score analysis did not indicate an exceptionally anomalous June observation within the five-year dataset. These findings indicate that airport resilience assessment should consider not only extreme disruptions but also changes in demand and environmental conditions that may increase operational complexity. Practically, the findings provide a basis for airport operators to incorporate exceptional flight-demand scenarios, extended operating periods, aircraft diversity, and weather exposure into operational readiness planning. This study contributes to a system-of-systems perspective on airport resilience assessment by using an actual exceptional-demand event as an observational case. Future research should integrate apron and terminal capacity data, facility utilization, turnaround time, delay performance, and higher-resolution weather observations to enable a quantitative Resilience Index calculation and provide a more comprehensive assessment of airport resilience.

ACKNOWLEDGMENT

The authors would like to express their gratitude to Dr. Ir. Kusnadi, S.T., M.T., Faculty of Engineering, Civil Engineering Study Program, Universitas Khairun Ternate, for his contribution as a research collaborator. The authors also extend their appreciation to Universitas Muhammadiyah Gorontalo, Djalaluddin Gorontalo Airport, and the Meteorology, Climatology, and Geophysical Agency (BMKG) for their cooperation, support, and provision of data and information that contributed to the implementation of this research. This research was independently funded by the two authors and received no external funding from any institution or organization.

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