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Integrating Risk Communication, Stakeholder Coordination, and Cognitive Resilience in Proactive Airport Safety at Yogyakarta International Airport

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ABSTRACT

Airport emergency management research has often examined operational procedures, stakeholder coordination, risk communication, and aviation human factors separately, limiting understanding of how organizational communication supports cognitive resilience and proactive safety in disaster-prone airports. This study examines how emergency management structures, risk communication, and multi-stakeholder coordination support proactive aviation safety at Yogyakarta International Airport. A qualitative single-case study was conducted through semi-structured interviews with 11 key informants, emergency preparedness document analysis, and field observations. Data were analyzed thematically using NVivo 12. Findings show that command structures, internal communication, stakeholder coordination, preparedness exercises, and information technology provide a strong operational foundation. However, public risk communication, message consistency, external communication technology, and post-disaster information management remain insufficiently integrated. The study proposes an Integrated Cognitive Resilience Framework connecting organizational enablers, communication conditions, cognitive mechanisms, cognitive resilience, and proactive safety outcomes. The framework highlights communication and coordination as mechanisms supporting shared situation awareness and adaptive decision-making under uncertainty.

1. INTRODUCTION

Airports are critical components of national transportation systems because they support passenger mobility, cargo distribution, emergency logistics, and regional economic activity. Their operational continuity depends on the ability of multiple units to manage safety risks within complex and rapidly changing conditions. Airports in disaster-prone areas face additional pressures because earthquakes, tsunamis, extreme weather, infrastructure failure, security incidents, and communication disruption may occur simultaneously. These conditions require airport safety management to extend beyond procedural compliance toward a proactive approach that anticipates emerging risks, supports adaptive decisions, and protects operational continuity (Herqutanto et al., 2022; Sivakumar, 2022). Formal emergency plans, evacuation facilities, command structures, and standard operating procedures remain essential. However, their effectiveness also depends on how information is interpreted, communicated, and coordinated across organizational boundaries. Price & Forrest (2016) emphasize that airport emergency preparedness requires clear authority, reliable communication, continuous training, and effective coordination among internal units and external agencies.

Risk communication is central to this process because emergency situations create uncertainty for airport personnel, passengers, public authorities, and surrounding communities. Information must be timely, accurate, consistent, and actionable so that different actors can understand the threat and respond appropriately. Communication failure may delay protective action, produce conflicting instructions, weaken inter-agency coordination, and reduce public trust. Effective risk communication therefore involves more than transferring technical information from authorities to target audiences. It requires a two-way process that connects expert knowledge, operational information, stakeholder responsibilities, and the needs of affected groups (Dougall et al., 2008; Selamet, 2019). Evidence from disaster events in Indonesia further shows that emergency communication is shaped by organizational flexibility, infrastructure availability, institutional coordination, and the ability to maintain communication when conventional systems are disrupted (Dougall et al., 2008; Yulianto et al., 2020). These findings indicate that communication technology alone cannot ensure an effective response unless it is supported by clear authority, message consistency, communication redundancy, and coordinated decision-making.

The operational value of communication becomes more apparent when airport emergency management is examined through cognitive processes. Situation awareness refers to the ability to perceive relevant information, understand its meaning, and anticipate how a situation may develop (Endsley, 1995). In aviation settings, situation awareness is closely connected to workload because personnel must monitor several sources of information, coordinate tasks, and make decisions within limited timeframes (Wickens, 2002). Excessive workload can narrow attention and reduce the capacity to process new information, while fatigue may weaken alertness, situation awareness, and control strategies. Bongo & Seva (2022) found that fatigue was associated with workload, situation awareness, and control strategies among air traffic controllers. These cognitive factors are not independent because the quality of a decision depends on the information available, the capacity of personnel to interpret it, and the effectiveness with which that interpretation is shared across units.

Cognitive resilience offers an integrative perspective for understanding how personnel and teams maintain reliable performance under pressure. It refers to the capacity to preserve or recover cognitive functioning when psychological stress and operational demands increase (Flood & Keegan,

2022). In an airport emergency context, this capacity is not shaped only by individual competence. It is also influenced by organizational conditions such as role clarity, information reliability, repeated exercises, distributed expertise, flexible coordination, and access to redundant communication channels. Clear information and well-defined responsibilities can reduce unnecessary cognitive demands, while coordinated communication can help personnel maintain situation awareness, prioritize tasks, and adjust decisions as conditions change. Cognitive resilience is therefore applied in this study as an interpretive perspective for examining how organizational arrangements support cognitive performance. It is not treated as an individual psychological variable that is directly measured through a standardized instrument.

Despite their relevance to airport safety, these areas of research remain theoretically fragmented. Airport emergency management studies generally concentrate on preparedness programs, command structures, operational procedures, facilities, and technical risk controls (Herqutanto et al., 2022; Holland et al., 2021; Sivakumar, 2022). Aviation human factors research, by contrast, commonly examines situation awareness, workload, fatigue, and decision-making as cognitive variables within particular occupational groups (Bongo & Seva, 2022; Endsley, 1995; Wickens, 2002) Risk and crisis communication studies place greater emphasis on message transparency, public trust, stakeholder participation, communication infrastructure, and organizational relationships (Dougall et al., 2008; Holland et al., 2021; Paton, 2008; Selamet, 2019; Yulianto et al., 2020). Although each body of research offers an important explanation, their separation leaves limited understanding of how organizational communication and coordination influence the conditions under which cognitive processes operate during emergencies.

More importantly, this conceptual separation leaves an unresolved organizational question. Human factors studies provide valuable evidence on workload, fatigue, situation awareness, and decision-making, but they provide less explanation of how communication practices, role structures, information flows, and inter-organizational coordination shape the conditions in which these cognitive processes occur. Conversely, disaster and risk communication studies frequently identify communication channels, stakeholder roles, institutional relationships, and information barriers without explicitly examining how these organizational mechanisms influence shared situation awareness, information-processing demands, and adaptive decision-making under uncertainty. The issue is therefore not simply whether emergency structures and communication systems are available, but whether they enable relevant information to be interpreted, verified, combined across organizational boundaries, and translated into coordinated action. Limited empirical attention has addressed this connection between organizational mechanisms and the cognitive conditions that support resilient emergency performance. Examining this relationship provides a basis for understanding cognitive resilience not solely as an individual capacity, but also as a capability supported by organizational arrangements that reduce uncertainty, coordinate expertise, and enable adaptation before operational risks escalate

This gap is particularly relevant to Yogyakarta International Airport, which operates in a coastal environment exposed to earthquake and tsunami hazards. The airport has emergency plans, command arrangements, coordination procedures, communication systems, and preparedness exercises involving internal units and external institutions. Nevertheless, the presence of these formal arrangements does not necessarily ensure that information will be interpreted consistently, exchanged effectively, or translated into coordinated action when conditions are uncertain and

rapidly changing. This distinction is important because emergency performance depends not only on procedural availability, but also on whether organizational arrangements enable different actors to construct a sufficiently shared understanding of the situation and adapt their decisions as new information emerges. Therefore, this study examines how emergency management structures, risk communication practices, and multi-stakeholder coordination create organizational conditions that support cognitive resilience and proactive aviation safety across preparedness, emergency response, and post-disaster learning. More specifically, it analyzes how command arrangements, communication channels, preparedness exercises, and information technology may support shared situation awareness, manage avoidable cognitive demands, facilitate adaptive decision-making, and enable organizational learning following emergency exercises and events. By connecting strategic communication, organizational coordination, and cognitive resilience, the study offers an integrative explanation of airport emergency management that extends proactive safety research beyond technical readiness and individual cognitive performance.

2. METHODS

Research Design

This study employed a qualitative single-case study design to examine how emergency management structures, risk communication practices, and multi-stakeholder coordination support proactive aviation safety at Yogyakarta International Airport. A qualitative approach was selected because the study sought to understand how formal emergency arrangements were interpreted and implemented by actors working within an actual airport environment. This approach also enabled the researchers to examine relationships between institutional procedures, communication practices, and operational experiences that could not be separated from their organizational context (Creswell & Creswell, 2018).

The case was bounded by one airport, a defined data collection period, and the emergency management process across the pre-disaster, emergency response, and post-disaster phases. The unit of analysis was the airport emergency management process, with particular attention to communication flows, command arrangements, stakeholder coordination, preparedness exercises, information technology, public information, and procedural implementation.

Cognitive resilience was used as an interpretive concept to examine whether organizational arrangements created conditions that could support situation awareness and adaptive decision-making. It was not treated as an individual psychological variable and was not measured through a standardized cognitive instrument. This distinction was necessary because the study focused on organizational communication and coordination rather than the psychological assessment of individual personnel.

Study Population, Sample, Location, and Period

The study population consisted of institutional actors who had direct knowledge of airport emergency preparedness, disaster response, operational communication, or inter-agency coordination. Participants were selected through purposive sampling because the study required information from individuals with responsibilities and experience that were directly relevant to the research objectives. Eligible participants met at least one of the following criteria: direct involvement in emergency preparedness or response, responsibility for internal or external communication, participation in emergency exercises, knowledge of command structures and emergency procedures,

or experience coordinating with airport units and external institutions. The final sample consisted of 11 key informants representing managerial, operational, technical, governmental, and community-based functions. These functions included corporate communication, aviation security, terminal and passenger services, air navigation services, meteorological services, emergency coordination, local disaster management authorities, and community disaster preparedness actors

Sample adequacy was assessed during data collection by monitoring the recurrence and depth of information across interviews. Recruitment was concluded when the final interviews repeated established patterns and did not produce substantively new categories concerning communication, coordination, preparedness, command arrangements, or emergency procedures. This approach was consistent with thematic saturation in purposive qualitative research (Guest et al., 2006). The research was conducted at Yogyakarta International Airport in Kulon Progo, Special Region of Yogyakarta, from February to April 2026. The airport was selected because it is critical transportation infrastructure located in a coastal area exposed to earthquake and tsunami hazards. It also has formal emergency plans, operational procedures, communication systems, preparedness exercises, and coordination mechanisms involving internal units and external institutions. These characteristics made the airport a relevant case for examining the organizational conditions that support proactive aviation safety.

Data Collection Techniques

Data were collected through semi-structured interviews, document analysis, and field observations. The use of multiple data sources enabled the researchers to compare formal institutional requirements with participant experiences and observed operational practices. It also supported the identification of consistencies, complementary evidence, and implementation gaps across sources.

- Semi-Structured Interviews

Semi-structured interviews explored participants' emergency responsibilities, internal communication, external stakeholder coordination, command activation, communication across disaster phases, preparedness exercises, procedure evaluation, monitoring technology, public risk communication, and decision-making conditions. A common interview guide was used to maintain consistency across participants, while follow-up questions allowed experiences associated with each participant's institutional role to be explored in greater depth.

The interviews were conducted in Indonesian and recorded with the participants' permission. Recordings were transcribed and checked for accuracy before analysis. Names, detailed positions, and information that could reveal personal identities were replaced with anonymized informant codes. Interview data were treated as accounts of organizational practices and experiences rather than as measurements of individual cognitive ability.

- Document Analysis

Document analysis covered the Airport Emergency Plan 2025, Airport Disaster Readiness Guidebook 2023, Earthquake and Tsunami Response Standard Operating Procedures 2026, safety and drill guidelines, exercise reports, and related operational records. Documents were included when they were institutionally authentic, sufficiently complete, applicable during the research period, and relevant to emergency preparedness, operational safety, communication, coordination, or one of the three disaster phases.Each document was examined for command structure, information flow, role allocation, evacuation procedures, communication channels, external

coordination, technology use, public information, and evaluation mechanisms. Documentary evidence established the formal expectations of airport emergency management and provided a basis for comparing written procedures with interview accounts and observed practices.

- Field Observation

Field observations were conducted during preparedness activities, emergency exercises, and tabletop simulations that were accessible during the research period. The observations focused on command activation, information movement to and from the Emergency Operation Center, communication between organizational levels, coordination with external institutions, hazard interpretation, task distribution, evacuation and passenger management, technology use, and message consistency. Field notes recorded the sequence of activities, communication channels, role performance, operational constraints, and visible differences between planned and implemented procedures. Particular attention was given to situations in which information required verification, transfer between units, or interpretation by more than one stakeholder. Observation records were subsequently compared with interview statements and institutional documents.

Data Analysis Techniques

The data were analyzed using qualitative thematic analysis. NVivo 12 was used to organize interview transcripts, institutional documents, field notes, codes, categories, and relationships among themes. The software supported systematic data management but did not replace researcher interpretation. The analysis began with repeated reading of the complete dataset to develop familiarity with the content and context of each source. A combination of deductive and inductive coding was then applied. Deductive codes were informed by the research objectives and included risk communication, stakeholder coordination, command structure, standard operating procedures, preparedness exercises, public information, information technology, and operational constraints. Inductive codes were developed from recurring issues and patterns that emerged directly from the data.

Related codes were compared and grouped into broader categories. The categories were reviewed across interviews, documents, and observations to develop themes that were internally coherent and supported by evidence from more than one source. Cross-source comparison was used to identify convergence, complementarity, and divergence. When sources differed, the analysis considered the participant's organizational role, the function and date of the document, and the operational context of the observation before an interpretation was developed. The final themes were interpreted through the concepts of risk communication, multi-stakeholder coordination, operational resilience, and proactive aviation safety. Situation awareness, workload, fatigue, decision-making, and cognitive resilience were applied cautiously as interpretive concepts. The analysis examined how communication quality, role clarity, exercises, coordination, and technology could support or constrain the organizational conditions required for reliable cognitive performance. This process provided a transparent analytical path from raw data to codes, categories, themes, and conceptual interpretation(Nowell et al., 2017; Patton, 2015).

Research Trustworthiness and Ethical Considerations

Research trustworthiness was addressed through credibility, dependability, confirmability, and transferability (Nowell et al. 2017). Credibility was strengthened through triangulation of interviews, documents, and observations. Dependability was supported through an audit trail containing the interview guide, participant selection criteria, field notes, coding records, and

analytical memos. Confirmability was maintained by linking interpretations to identifiable evidence from the dataset and examining differences among sources rather than excluding contradictory information. Transferability was supported through a detailed description of the airport context, participant functions, data sources, and analytical procedures. The study sought analytical insight into airport emergency management rather than statistical generalization.

Participants received information about the purpose of the study, voluntary participation, confidentiality, and the academic use of the data. Interviews were conducted after participants provided consent. Names and identifying details were removed from transcripts and research outputs. Informants were represented through anonymized codes, and findings were reported at the organizational level rather than attributed to individual personnel. Digital recordings, transcripts, and analytical files were stored securely and accessed only for research purposes.

3. RESULTS

The findings indicate that coordination among internal units and external stakeholders at Yogyakarta International Airport operates within a clearly defined structural framework. Command structures and Emergency Operation Center activation protocols support rapid response, yet public communication integration remains limited (Sivakumar, 2022). The results are presented in three main sections: thematic codes from interviews and documents, an emergency management coordination flowchart, and a summary of findings based on official airport documents and relevant literature. The analysis emphasizes risk communication, multi-stakeholder coordination, and airport operational readiness.

3.1. Thematic Codes from Interviews and Documents

Coding of interviews with eleven key informants and analysis of official airport documents revealed five primary themes relevant to airport emergency management. These themes were used to evaluate procedural effectiveness, internal and external communication, and multi-stakeholder coordination.

Table 1. Thematic Codes from Analysis

Theme code	Definition	Indicator	Data source
KOM	Internal and external communication during emergencies	EOC information flow, reports to internal units, communication with BMKG and BPBD	Interviews, PKD 2025, SOP 2026
SIN	Command structure and hierarchy	Incident Command Structure, EOC positioning, Mobile Command Post	Interviews, GARD 2023 Document
SOP	Compliance with operational procedures	Emergency response SOP activation, evacuation routes, checklist usage	SOP 2026, Airport Disaster Readiness Guidebook 2023
LAT	Preparedness drills and simulations	Tabletop exercises, full-scale drills, drill evaluation reports	DFX 2023 Report, PKD 2025
TI	Information technology and monitoring systems	EOC dashboards, public communication systems, evacuation route monitoring	PKD 2025 Document, field observations

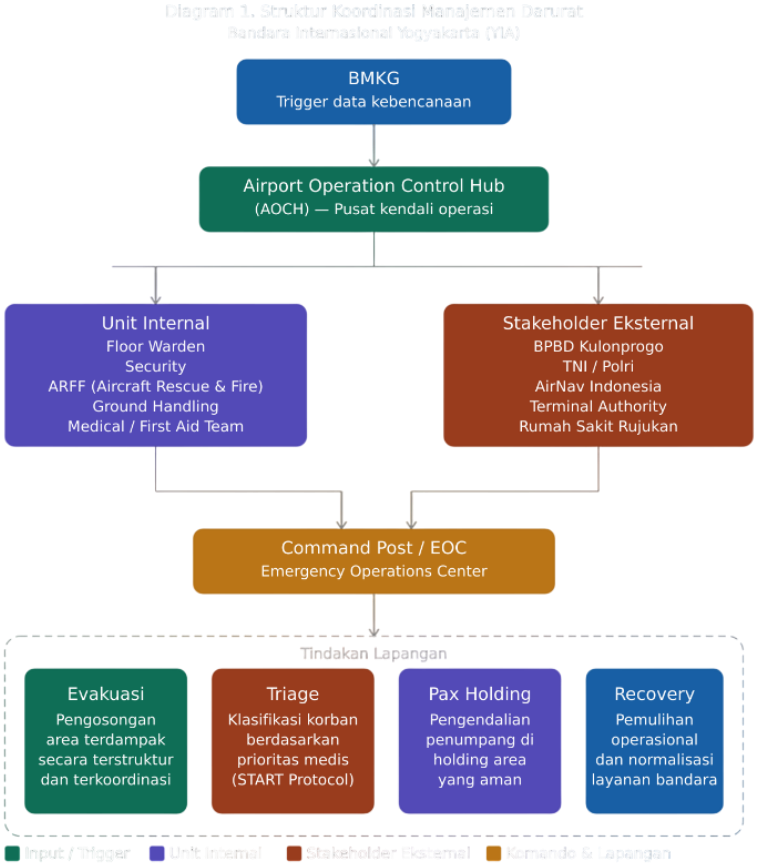
Coding results indicate that internal communication and command structure dominate airport preparedness documentation and practice. While SOP and LAT reflect strong technical procedures, information technology aspects and public information integration remain relatively limited. This

aligns with international literature emphasizing technology-based communication systems for enhancing airport operational resilience (Schmölter et al., 2026).

3.2. Implementation of the Delegation Mandate

Based on airport documents and interviews, emergency coordination mechanisms follow a hierarchical command structure that integrates internal airport units with external stakeholders. The coordination chart illustrates communication pathways and responsibilities during the emergency response phase.

Flow Diagram 1. Emergency Management Coordination Structure of Yogyakarta International Airport



This diagram shows that BMKG serves as the primary information trigger, forwarding official alerts to the AOCH. The AOCH manages internal coordination with floor wardens, security personnel, and other operational units. External stakeholders such as BPBD, TNI, Polri, and AirNav Indonesia are integrated through formal coordination channels. Interview findings reveal that although normative communication pathways are clearly defined, strategic coordination and public narrative control remain suboptimal, particularly during pre-disaster and post-disaster phases.

Combining interview results, official documents, and primary findings, airport preparedness can be categorized into three phases.

a. Pre-Disaster Phase

Airport authorities conduct planning and preparation activities by developing SOPs and preparedness documents covering over sixty-six stakeholders, risk identification, and disaster impact probability matrices. Internal communication involves AOCH conducting routine

briefings for internal units, including personnel deployment, evacuation route availability, and emergency equipment simulation training. External coordination relies on BMKG as the primary information source for disaster-related data, weather forecasts, and seismic activity. Interviews indicate a dependency on a single data source, which introduces a residual risk of information inaccuracy.

b. Emergency Response Phase

During emergencies, SOP activation involves Emergency Operation Center deployment led by the General Manager, who coordinates internal units and external agencies. Multi-stakeholder coordination is facilitated through the AOCH, which serves as the liaison between internal and external parties. Tabletop exercises demonstrate rapid response capabilities, yet public narrative control and passenger communication require enhancement. Evacuation execution, route adjustments, assembly point designation, and triage area operations follow established protocols. Observations confirm effective operational workflows, although some staff report difficulties in consistently delivering risk information to the public.

c. Post-Disaster Phase

Following the response phase, operational recovery becomes the primary focus. Airport documents outline procedures for terminal, apron, and ATC facility restoration, along with evaluation and learning mechanisms. Drill outcomes and emergency implementations are used to refine procedures. However, interview results indicate that post-disaster risk communication, media management, and rumor control lack strategic integration. Technology integration through dashboards and monitoring systems supports internal coordination, yet technology-driven public communication remains underoptimized. Recent literature demonstrates that technology-based information systems improve multi-stakeholder coordination effectiveness (Schmölter et al., 2026).

Taken together, the findings show that the organizational foundations of emergency management at Yogyakarta International Airport are stronger than their communicative integration across the full disaster cycle. Clear command structures, defined stakeholder roles, preparedness exercises, and internal monitoring systems provide relatively stable pathways for obtaining and coordinating operational information. However, limitations in public risk communication, message consistency, technology-supported external communication, and post-disaster information management create points at which information may require additional verification, interpretation, or translation before it can support coordinated action. From an organizational perspective, these patterns indicate that formal preparedness can support, but does not by itself guarantee, the information conditions required for shared situation awareness and adaptive decision-making. These cognitive implications are interpreted from communication and coordination patterns identified across interviews, documents, and observations. They should not be understood as direct measurements of individual cognitive performance.

4. DISCUSSION

4.1 From Procedural Readiness to Proactive Aviation Safety

The central implication of the findings is that procedural readiness does not automatically produce operational readiness. Plans, standard operating procedures, command structures, and emergency facilities establish essential controls, but their value depends on whether they support

rapid interpretation, coordinated action, and adaptation as conditions change. Proactive aviation safety therefore requires management to identify communication weaknesses, coordination gaps, and decision pressures before they develop into operational failures. This interpretation is consistent with integrated risk management, which treats airport functions as interdependent rather than isolated(Price & Forrest, 2016; Sivakumar, 2022).

At Yogyakarta International Airport, formal arrangements provide a strong basis for response, yet they must remain flexible enough to accommodate events that exceed planning assumptions. Clear authority can accelerate decisions, while excessive hierarchy can delay action when operational personnel hold the most relevant information. Proactive preparedness therefore combines procedural control with defined operational discretion, continuous evaluation, and the ability to detect weak signals before disruption escalates.

4.2 Risk Communication as an Enabler of Shared Situation Awareness

Risk communication should be understood as a mechanism for developing shared situation awareness rather than merely distributing warnings. In airport emergencies, meteorological agencies, air traffic services, terminal personnel, security units, and airport management hold different parts of the operational picture. Situation awareness becomes collective when these perspectives are communicated, interpreted, and combined into a coherent understanding of the threat (Endsley, 1995). Communication quality therefore depends on accuracy, timeliness, relevance, consistency, accessibility, and the ability to translate technical information into operational instructions.

The gap between internal operational information and public communication has direct safety implications. Passengers who do not understand the threat, the reason for an instruction, or the location of safe areas may respond slowly, seek unofficial information, or increase the workload of frontline personnel. Transparent and consistent messages influence public evaluation and coordinated interpretation during crises (Holland et al., 2021; Zhao & Oh, 2021). Public communication should therefore be incorporated into the same information architecture used for operational coordination. This requires agreement on message authority, verification procedures, update frequency, and the channels used for different passenger groups. It also requires frontline staff to receive verified information at the same time as management so that face-to-face instructions do not contradict digital or public address messages.

4.3 Multi-stakeholder Coordination and Adaptive Decision Making

Multi-stakeholder coordination is not simply the presence of several institutions. It is the process through which coordinated decisions are converted into coordinated decisions. The Emergency Operation Center and AOCH perform this boundary-spanning role by linking internal units with BMKG, BPBD, AirNav Indonesia, and other actors. Their importance lies in reducing interpretive fragmentation and establishing a common basis for action. Reliable coordination requires both strategic control and operational flexibility. Centralized command clarifies accountability, while limited decentralization allows personnel with direct situational knowledge to act when conditions change quickly.

Paton (2008) show that disaster communication becomes more reliable when coordination is combined with flexibility, organizational learning, and access to expertise. Shared terminology, escalation procedures, recurring interaction, and clearly distributed authority are therefore necessary if stakeholder involvement is to improve decision quality rather than remain procedural.

Coordination quality should also be assessed before emergencies through joint planning, interoperable communication practices, and agreement on how uncertainty will be communicated. These preparations reduce the need to negotiate authority and terminology while an incident is already developing.

4.4 Cognitive Workload, Fatigue, and Resilient Performance

This study did not directly measure workload or fatigue, but the organizational patterns provide a basis for interpreting how emergency systems influence cognitive demands. Workload rises when personnel must verify conflicting messages, coordinate multiple actors, and perform time-sensitive tasks. Because attention is limited, excessive information demand may narrow attention and reduce situation awareness (Wickens, 2002). Fatigue can intensify these effects by weakening vigilance and information processing, as shown in research with air traffic controllers(Bongo & Seva, 2022).

Communication systems can either increase or reduce avoidable cognitive demand. Fragmented messages and unclear roles require repeated verification, while standardized formats, clear reporting paths, role clarity, practiced procedures, and visual dashboards allow personnel to devote more attention to threat assessment. Cognitive resilience is therefore partly an organizational outcome. It emerges when personnel can maintain or recover effective cognitive performance through reliable information, flexible coordination, repeated training, and access to relevant expertise(Flood & Keegan, 2022).

4.5 Preparedness Drills as Mechanisms of Cognitive and Organizational Learning

Preparedness exercises should be evaluated as mechanisms of cognitive and organizational learning, not only as tests of procedural compliance. Drills allow personnel to recognize hazard signals, communicate across units, interpret incomplete information, and make decisions under controlled pressure. Repetition builds familiarity with information sources, reporting paths, roles, and decision authority, while also revealing communication gaps that may remain hidden in written plans(Price & Forrest, 2016). Exercises should therefore include inconsistent information, communication failure, passenger behavior, misinformation, media demands, and simultaneous operational pressures. Post-exercise evaluation must connect identified weaknesses with assigned corrective actions, procedural revision, training priorities, and subsequent testing. Without this feedback cycle, drills risk becoming demonstrations of compliance rather than instruments of proactive safety improvement.

4.6 Multi-stakeholder Coordination and Adaptive Decision Making

Information technology supports emergency management when it consolidates critical information, reduces search demands, and provides a shared operational display. Dashboards can strengthen situation awareness by presenting hazard information, operational status, evacuation routes, and resource availability in a structured form. Poorly designed systems, however, may increase workload through excessive alerts and disconnected interfaces. Technology should therefore be selected according to operational and human-factor requirements.

Resilience also requires channel redundancy. During the Palu disaster, electricity and cellular failures disrupted communication, while two-way radio, satellite phones, and mobile base stations supported coordination(Yulianto et al., 2020). Internal dashboards should be connected with public address systems, digital signage, mobile alerts, social media, and frontline communication. Two-way

channels can also incorporate information from personnel, passengers, and surrounding communities, supporting a more complete risk picture(Selamet, 2019).

4.7 An Integrated Cognitive Resilience Framework for Airport Emergency Management

The study proposes an Integrated Cognitive Resilience Framework that connects five components. Organizational enablers include command structures, standard operating procedures, stakeholder role clarity, preparedness exercises, redundant communication channels, and information technology. These elements establish the formal and technical conditions for coordinated emergency management. They shape communication conditions based on accuracy, timeliness, consistency, accessibility, transparency, and opportunities for feedback. Effective communication then supports cognitive mechanisms such as shared situation awareness, workload regulation, threat interpretation, and adaptive decision-making. The framework therefore explains how formal management arrangements influence the way personnel and teams process information rather than assuming that procedures directly produce safe outcomes.

Cognitive resilience represents the capacity of personnel and teams to maintain or recover effective cognitive performance under uncertainty and operational pressure. It emerges from the interaction between trained personnel, reliable information, flexible coordination, supportive technology, and access to relevant expertise. The resulting proactive safety outcomes include response efficiency, passenger protection, operational continuity, stakeholder trust, and prevention of escalating failures. The framework also includes a post-disaster and post-exercise learning process in which evaluation findings are translated into revisions to procedures, training, communication practices, technology, and stakeholder arrangements. This learning cycle is important because the relationship is recursive rather than purely linear. Operational outcomes generate new information that can strengthen or expose weaknesses in the organizational enablers used in subsequent emergencies. The effect of each component also depends on context. A communication system that performs adequately during a routine disruption may be insufficient during a multi-hazard event involving infrastructure failure, passenger congestion, and uncertain external information. Resilience should therefore be assessed through scenarios that vary in complexity, duration, information quality, and communication availability.

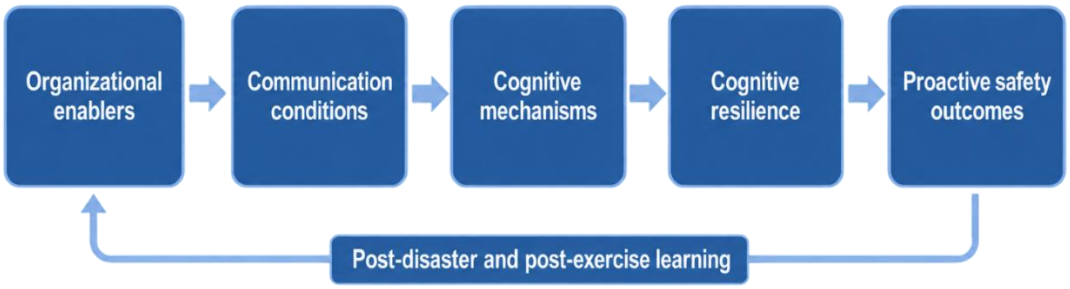


Figure 1. *Cognitive Resilience Framework*

4.8 Theoretical Contribution

The theoretical contribution of the study lies in connecting airport emergency management, strategic communication, stakeholder coordination, and cognitive resilience within one analytical framework. Airport management research often emphasizes procedures and infrastructure, human

factors research examines individual cognitive variables, and communication research focuses on messages and relationships. The framework integrates these perspectives by positioning communication and coordination as organizational conditions that shape cognitive performance. It also extends cognitive resilience beyond individual endurance by showing how role clarity, information quality, command flexibility, and collective expertise influence the ability of personnel to maintain reliable performance under pressure.

This position explains why formal preparedness alone may be insufficient. Procedures become operationally effective when they help personnel construct a shared understanding, regulate information demand, and adapt decisions without losing coordination. Communication failures should therefore be treated as safety risks because they may weaken situation awareness and decision quality even when technical systems remain functional. The framework further contributes to the study of disaster-prone airports, where aviation safety depends on coordination with institutions outside the aviation sector. It provides a basis for examining how airport operations, public communication, disaster governance, and community information can be integrated across different hazard contexts. It also reframes communication as an operational safety resource rather than a supporting public relations activity. When communication affects shared situation awareness, workload, and adaptive decisions, its quality becomes relevant to the same management processes used to evaluate procedures, technology, staffing, and command performance.

4.9 Practical Implications for Airport Management

Airport management should evaluate emergency communication as part of the safety management system rather than as an administrative support activity. Relevant indicators include message delivery time, consistency across units, passenger comprehension, stakeholder feedback, and channel redundancy. Exercises should incorporate communication and cognitive pressures, including conflicting information, simultaneous incidents, system failure, misinformation, passenger anxiety, and high workload. The Emergency Operation Center should maintain strategic control while defining the circumstances in which personnel with direct situational knowledge may exercise operational discretion. These arrangements can improve response speed without weakening accountability. Evaluation should also examine whether information remains understandable when operational conditions change, whether frontline personnel receive updates at the same time as decision-makers, and whether external stakeholders can use compatible communication procedures.

Public communication must also be integrated with operational decisions through verified message templates, multilingual instructions, digital alerts, media protocols, trained spokespersons, and consistent information for frontline personnel. Technology should present prioritized information and remain usable when normal infrastructure is disrupted. Findings from exercises, actual disruptions, passenger feedback, and stakeholder evaluations should be translated into assigned corrective actions, revised procedures, training priorities, and technology improvements. Progress should be reviewed in subsequent exercises so that learning becomes continuous rather than episodic. This process is essential for converting emergency preparedness into proactive aviation safety.

5. CONCLUSION

This study shows that effective emergency preparedness at Yogyakarta International Airport depends on the interaction between formal procedures, reliable communication, coordinated

responsibilities, and adaptive decision-making. Internal command arrangements, stakeholder coordination, and preparedness exercises provide a strong operational foundation. However, public risk communication, message consistency, external communication technology, and post-event information management require further integration. The study contributes an organizational interpretation of cognitive resilience. The proposed framework explains how organizational enablers shape communication conditions, which influence shared situation awareness, workload regulation, threat interpretation, and adaptive decision-making. These mechanisms support cognitive resilience and proactive safety outcomes. Cognitive resilience is therefore not only an individual capability. It is also enabled by systems that clarify authority, reduce uncertainty, support information processing, coordinate expertise, and promote learning before risks escalate into operational failures. This integrative position is the main conceptual novelty of the study.

Practically, airport management should integrate public communication into emergency command, test communication pressures during exercises, provide redundant channels, and design dashboards as cognitive support tools. The Emergency Operation Center should combine centralized coordination with defined operational discretion, while verified multilingual messages, digital alerts, media protocols, and regular evaluation should strengthen passenger compliance and stakeholder trust. Implementation should be supported by clear ownership of each corrective action, an agreed completion schedule, and follow-up assessment during the next exercise. This approach ensures that recommendations are translated into operational change rather than remaining in evaluation reports. Regular review is also necessary because stakeholder roles, technology, passenger characteristics, and hazard information can change over time.

The single-case qualitative design limits statistical generalization, and cognitive determinants were interpreted rather than directly measured. The evidence also reflects the institutional arrangements and hazard profile of one airport during a specific research period. Future research should test the framework across international, regional, and disaster-prone airports using comparative, quantitative, mixed-method, and longitudinal designs. Such studies can examine how communication quality, workload, fatigue, situation awareness, decision-making, training, and technology jointly influence cognitive resilience and proactive aviation safety. Direct cognitive measures, exercise performance data, passenger response, and post-event evaluations could also be combined to assess whether improvements in organizational enablers produce measurable safety outcomes over time.

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