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Enhancement of Incident Command System on Commercial Aircraft Accident Management at Bicol Airport

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ABSTRACT

This research examined the implementation of the Incident Command System (ICS) in managing on-airport commercial aircraft accidents at Bicol Airport. The study aimed to examine existing emergency response policies, protocols, and practices, assess personnel preparedness, identify challenges encountered in ICS implementation, and propose an enhanced ICS framework. Data were gathered through document analysis of the Aerodrome Emergency Plan (AEP), a questionnaire administered to 27 operational Aerodrome Rescue and Firefighting (ARFF) personnel, and key informant interviews with the heads of ARFF, PNP-AVSEU, CSIS, and the Medical Unit. The findings revealed that although the AEP addresses several ICS components, gaps remain in organizational structure, clarity of command relationships, and environmental management integration. Concerns included overlapping ICS and Emergency Operations Center (EOC) arrangements and the concurrent assignment of Incident Commander and Operations Section Chief responsibilities. The survey findings indicated that ARFF respondents perceived themselves as prepared to perform their assigned emergency response duties. However, the survey did not establish the effectiveness of unified command, interagency coordination, or ICS planning during joint aircraft response, as the respondents reported no qualifying participation under the relevant screening question. Key informant interviews identified challenges involving personnel, communication, training, resources, organizational arrangements, and environmental management. Based on these findings, the study proposed an enhanced ICS framework that clarifies command responsibilities, distinguishes incident-level ICS operations from EOC support functions, and provides a flexible and scalable organizational structure. The proposed framework is intended to strengthen resource mobilization, interagency coordination, communication, and environmental management while complementing the airport's emergency management arrangements.

Keywords: *Incident Command System (ICS), aircraft accident management, airport emergency management, emergency preparedness, Bicol Airport*

INTRODUCTION

Aviation plays a vital role in global connectivity, facilitating the movement of people, goods, and services across international boundaries. As one of the world's most dynamic sectors, air transport supports economic growth, trade, and tourism, yet it also faces complex safety and emergency management challenges. With millions of passengers and tons of cargo transported daily, airports must be prepared to respond quickly and efficiently to various emergencies, including aircraft accidents, natural disasters, and public health crises. The International Civil Aviation Organization (ICAO) underscores the importance of comprehensive airport emergency planning, emphasizing the need for a structured command system,

defined roles, and effective coordination among multiple responding agencies to ensure safety and operational continuity during crises (ICAO, 1991).

Globally, the Incident Command System (ICS) has emerged as a fundamental framework for effective emergency management. ICS provides a standardized, on-scene, all-hazard structure that facilitates coordinated response among diverse agencies and stakeholders. Originally developed in the United States for managing wildfire incidents, ICS has evolved into a widely adopted emergency management model that can be adapted to different scales and types of incidents. Its principles of modular organization, clear command hierarchy, defined responsibilities, and common terminology support coordinated emergency response and resource management (FEMA, 2017).

At the national level, the Republic of the Philippines, through Republic Act No. 10121, or the Philippine Disaster Risk Reduction and Management Act of 2010, mandates a comprehensive and coordinated approach to disaster preparedness and response. The Implementing Rules and Regulations (IRR) of RA 10121 provide the operational framework for implementing the law, including the roles, responsibilities, and coordination mechanisms of government agencies to support a unified approach to disaster management (Republic of the Philippines, 2010). To operationalize these provisions, the National Disaster Risk Reduction and Management Council (NDRRMC), through the Office of Civil Defense (OCD), issued Memorandum Circular No. 4, s. 2012, which provides guidelines for the institutionalization and use of ICS as an on-scene emergency management system. These policy instruments establish the national context for standardized command, control, coordination, and emergency response procedures, including their application in specialized settings such as airports (NDRRMC, 2012).

In the aviation sector, the Civil Aviation Authority of the Philippines (CAAP) provides guidance for airport emergency preparedness, including the development and implementation of Aerodrome Emergency Plans (AEPs) (CAAP, 2022). Airports also implement Safety Management Systems (SMS) to support aviation safety and risk management (CAAP, 2023). Within this context, effective implementation of the Incident Command System (ICS) in airport emergencies requires not only established policies but also clear organizational structures, appropriate resource mobilization, trained personnel, effective inter-agency coordination, reliable communication

At Bicol Airport, the Aerodrome Emergency Plan (AEP) serves as the primary airport-specific document establishing procedures, responsibilities, and coordination arrangements for responding to aerodrome emergencies. It provides the operational basis for emergency preparedness and response among the concerned airport units and responding agencies. In this regard, examining the AEP provides an opportunity to determine how the airport's existing emergency response arrangements incorporate the principles and essential components of the Incident Command System (ICS), particularly in managing on-airport commercial aircraft accidents.

Locally, Bicol Airport, one of the country's important aviation gateways, serves as a major transportation hub for the Bicol Region. With continuing airport operations and the need to maintain emergency readiness, Bicol Airport must ensure that its emergency response arrangements are consistent with applicable national and international standards. This study focuses specifically on the management of on-airport commercial aircraft crashes at Bicol Airport. In such emergencies, an effective ICS framework is necessary to establish clear command relationships, coordinate responding units, mobilize resources, and support timely and organized emergency response.

Effective management of on-airport commercial aircraft crashes requires coordinated action among airport authorities, emergency responders, aviation security personnel, medical teams, and other concerned agencies. The Incident Command System (ICS) provides a structured approach for establishing command authority, defining responsibilities, coordinating operations, managing resources, and facilitating communication during emergencies. However, the existence of an established emergency management framework does not necessarily ensure that its organizational arrangements and operational provisions are

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fully aligned with ICS principles or that personnel are adequately prepared to perform their assigned functions.

Globally, the Incident Command System (ICS) is widely recognized as an effective approach to managing disasters and large-scale emergencies. It provides a structured system that enables different agencies to coordinate their activities, manage resources, and respond according to clearly defined responsibilities (Bigley & Roberts, 2001). The system is flexible and can be adapted according to the size, complexity, and characteristics of an emergency. However, studies indicate that effective ICS implementation depends on factors such as leadership, organizational support, inter-organizational relationships, and regular training and exercises (Jensen & Thompson, 2016). Researchers have likewise emphasized that although ICS provides standardized principles, its implementation must consider local organizational and operational conditions to achieve effective coordination (Buck, Trainor, & Aguirre, 2006).

In the aviation industry, ICS principles are particularly relevant to airport emergency management because commercial aircraft crashes require the simultaneous involvement of multiple response organizations. The International Civil Aviation Organization (ICAO) provides guidance on airport emergency planning that emphasizes defined responsibilities, command arrangements, communication, and coordination among responding agencies (ICAO, 1991). These principles are consistent with the objectives of ICS and demonstrate the importance of structured emergency response arrangements in airport environments. Research also emphasizes the importance of continuous training, regular emergency exercises, and inter-agency collaboration in strengthening the effectiveness of Airport Emergency Plans (AEPs) (Price & Forrest, 2016). The ICS structure, consisting of Command, Operations, Planning, Logistics, and Finance/Administration functions, provides a flexible organizational basis for managing complex emergencies (FEMA, 2010).

In the Philippines, Republic Act No. 10121, or the Philippine Disaster Risk Reduction and Management Act of 2010, established a national disaster risk reduction and management system that requires coordinated preparedness and response among government agencies (Republic of the Philippines, 2010). NDRRMC Memorandum Circular No. 4, s. 2012 further provides guidance for the institutionalization and use of ICS as an on-scene management system. Within the aviation sector, CAAP requires airports to maintain emergency preparedness and response arrangements consistent with applicable aviation safety standards, including Airport Emergency Plans (AEPs) and Safety Management Systems (SMS). Despite these frameworks, challenges may remain in translating formal ICS requirements into effective airport-level practices, particularly in relation to training, resource availability, inter-agency coordination, communication, and organizational clarity.

Environmental management is likewise an important consideration in airport emergency planning. Commercial aircraft crashes may involve fuel spills, hazardous materials, fire suppression activities, contaminated materials, and other conditions that can create environmental risks. In the Philippines, the Environmental Impact Statement (EIS) System established under Presidential Decree No. 1586 (1978) and implemented through DENR Administrative Order No. 2003-30 provides a regulatory framework for assessing and managing environmental impacts. Although these instruments primarily address environmental impacts associated with projects and activities, they reinforce the importance of considering environmental protection within airport operations and emergency management. Integrating environmental considerations into aircraft crash response can therefore complement existing safety and emergency management arrangements.

At the local level, limited researches have specifically examined the implementation and enhancement of ICS for on-airport commercial aircraft crash management in Philippine regional airports. Existing research emphasizes the importance of continuous training, organizational preparedness, safety culture, and inter-agency coordination in improving emergency response (Abuan, Corpuz, & Carmen, 2023). However, there remains a need for context-specific assessment of how existing airport emergency

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plans, personnel preparedness, organizational arrangements, resource requirements, communication procedures, and environmental considerations interact within an ICS-based aircraft crash response system. This gap is particularly relevant to Bicol Airport, where the development of an enhanced framework requires consideration of the airport's existing emergency response structure and the operational realities of its response units.

In summary, ICS is supported by international emergency management principles and Philippine policies and is relevant to the coordination of complex airport emergencies. However, the effectiveness of ICS depends on how its principles are translated into actual organizational structures, personnel preparedness, resource arrangements, inter-agency coordination, communication procedures, and operational practices. The identified gaps and the limited context-specific research on ICS for on-airport commercial aircraft crash management in regional Philippine airports highlight the need for an enhanced framework for Bicol Airport. Such a framework can provide a structured basis for strengthening command and control, preparedness, coordination, resource management, and environmental management during on-airport commercial aircraft crash response.

Although the Incident Command System (ICS) is widely recognized and institutionalized in the Philippines through Republic Act No. 10121 and NDRRMC guidelines, its practical application in airport emergency management remains an area requiring further examination. Existing literature indicates that ICS can enhance coordination, communication, resource management, and decision-making during emergencies. However, the effective implementation of these principles may vary depending on the organizational structure, resources, training, operational conditions, and interagency relationships of individual airports. In regional airport settings such as Bicol Airport, there is a need to examine how existing ICS arrangements address these operational requirements, including the integration of environmental management into emergency response.

Existing research has examined ICS in general emergency management and airport emergency preparedness; however, there is limited research providing a practical, context-specific framework for enhancing ICS implementation during on-airport commercial aircraft crash response at regional airports in the Philippines. Existing Airport Emergency Plans (AEPs) and Safety Management Systems (SMS) provide important policy and procedural foundations for emergency management, but the extent to which ICS principles are translated into clear organizational structures, defined roles, training requirements, resource arrangements, communication procedures, interagency coordination, and environmental response measures requires further examination within the specific operational context of Bicol Airport.

This gap highlighted the need for a structured, context-specific framework that bridges established ICS policies and their practical implementation at Bicol Airport. Such an enhancement can provide clearer organizational and operational arrangements for on-airport commercial aircraft crash response, strengthen coordination and preparedness among responding units, support effective resource mobilization and communication, and incorporate environmental considerations into emergency response. The proposed framework is therefore intended to address the identified gaps in the existing ICS arrangements of Bicol Airport while remaining responsive to the operational realities of a regional airport.

Objectives of the Study

To propose an enhancement of Incident Command System on Commercial Aircraft Accident Management of Bicol Airport.

1. To examine existing policies, standards, and emergency management practices for commercial aircraft accidents at Bicol Airport along the following:
    1.1 Skills training of emergency response employees;
    1.2 Resource allocation and mobilization;
    1.3 Interagency coordination and collaboration;
    1.4 Integration of Environmental Management into emergency procedures; and

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1.5 ICS Organizational Structure.

2. To determine the level of preparedness of Bicol Airport personnel based on ICS protocols along the following areas:
   - 2.1 Aerodrome Rescue and Firefighting (ARFF) operations;
   - 2.2 Aviation security measures;
   - 2.3 Enforcement of safety and emergency protocols;
   - 2.4 Medical emergency response; and
   - 2.5 Interagency coordination and communication.
3. To identify challenges encountered by Bicol Airport in the implementation of ICS protocols during aircraft related emergencies; and
4. To propose an enhanced Incident Command System Framework on Commercial Aircraft Accident Management at Bicol Airport.

Theoretical Framework

This study is anchored on Systems Theory (Bertalanffy, 1968) and Contingency Theory (Fiedler, 1964). These frameworks provide the foundation for developing a structured and adaptable framework for enhancing the Incident Command System (ICS) in managing commercial aircraft accidents at Bicol Airport. Collectively, they explain the importance of inter-agency coordination, the adaptability of organizational structures during emergencies, and the need for appropriate systems and standards for effective emergency management.

Systems Theory, developed by Ludwig von Bertalanffy, views organizations as complex systems composed of interrelated and interdependent components that must function cohesively to achieve shared objectives. Each part contributes to the performance of the whole, and the effectiveness of the system relies on the continuous exchange of information and coordination among its components. In the context of this study, Bicol Airport is viewed as a system comprising interconnected units, including airport management, aviation authorities, fire and rescue services, medical teams, security personnel, and other relevant emergency response entities, that must collaborate effectively during emergencies. The Incident Command System (ICS) reflects the principles of Systems Theory by providing a structured command and coordination mechanism that facilitates communication and collaboration among these entities. Applying this theory emphasizes the importance of integrating the functions of different response units into a coordinated emergency management system to promote efficiency, effective resource utilization, and clarity of command during on-airport commercial aircraft crashes.

Complementing this, Contingency Theory, associated with Fred Fiedler, emphasizes that there is no universal or single best way to manage an organization; rather, effectiveness depends on the situation, context, and environment in which decisions are made. This theory supports flexibility and adaptability as essential features of effective organizational management. Applied to this study, Contingency Theory provides the rationale for the scalable and adaptable nature of ICS, which can be modified depending on the magnitude and complexity of an incident. At Bicol Airport, the ICS structure and response arrangements must be capable of adapting to the specific conditions and operational requirements of an on-airport commercial aircraft crash, including the number of affected persons, available resources, hazards present, and agencies involved. Thus, Contingency Theory reinforces the importance of designing an ICS framework that is flexible and responsive to the varying operational demands of aircraft crash response.

In summary, the integration of ICS into Bicol Airport 's emergency management can be understood through these theoretical perspectives. Systems Theory underscores the importance of interdependent response units functioning as a coordinated system, while Contingency Theory emphasizes flexibility and context-based decision-making during emergencies. Together, these frameworks provide a coherent foundation for developing an enhanced ICS framework that strengthens preparedness, improves inter-

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agency coordination, clarifies organizational roles, and supports a systematic and adaptable response to on-airport commercial aircraft crashes.

Conceptual Framework

The conceptual framework of this study illustrates the process through which the existing Incident Command System (ICS) arrangements at Bicol Airport are examined and enhanced for commercial aircraft accident management. It presents the logical flow of the study, beginning with the assessment of existing emergency management arrangements, followed by the analysis and identification of gaps, and culminating in the development of the proposed Enhanced ICS Framework.

The framework is anchored on the understanding that effective emergency response depends on several interrelated components. These include existing policies, standards, and emergency management practices; the current preparedness and capabilities of airport personnel and response units; and the challenges and gaps affecting ICS implementation. These components constitute the existing emergency management system examined in the study.

The study analyzed these existing arrangements through document analysis of the Bicol Airport Aerodrome Emergency Plan (AEP), assessment of the perceived preparedness of operational ARFF personnel, and key informant interviews with the heads of ARFF, CSIS, Medical Unit, and PNP-AVSEU. The assessment focused on skills training, resource allocation and mobilization, interagency coordination and collaboration, environmental management integration, ICS organizational structure, communication, operational response, and other relevant ICS protocols.

The findings from these sources are then analyzed and compared with established emergency management principles, policies, and standards, particularly those of the International Civil Aviation Organization (ICAO), Civil Aviation Authority of the Philippines (CAAP), Federal Emergency Management Agency (FEMA), and the Philippine disaster risk reduction and management framework under Republic Act No. 10121. This process identifies strengths, gaps, and areas requiring enhancement in the existing ICS arrangements at Bicol Airport.

The outcome of this process is the proposed Enhanced Incident Command System Framework for Commercial Aircraft Accident Management at Bicol Airport. The framework is intended to strengthen command and control, clarify organizational roles and responsibilities, improve interagency coordination and communication, support effective training and resource management, integrate environmental considerations, and provide a flexible and scalable response structure appropriate to on-airport commercial aircraft crash response.



Figure 1. *Theoretical and Conceptual Framework Model*

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METHODS

Research Design

This study employed a developmental-descriptive research design. The descriptive component examined the existing policies, standards, practices, protocols, and preparedness related to the implementation of the Incident Command System (ICS) in the management of on-airport commercial aircraft accidents at Bicol Airport.

The descriptive component specifically examined skills training, resource allocation and mobilization, interagency coordination and collaboration, environmental management integration, communication procedures, operational response procedures, and ICS organizational structure. The quantitative assessment of perceived preparedness was based on the responses of operational ARFF personnel, while qualitative information regarding the preparedness and operational practices of the other key response units was obtained through key informant interviews with their respective unit heads.

The developmental component involved the formulation of a proposed Enhanced Incident Command System Framework for Commercial Aircraft Accident Management at Bicol Airport. The framework was developed from the synthesis of findings obtained through document analysis, the survey questionnaire, and key informant interviews. Identified strengths, gaps, challenges, and operational needs served as the basis for determining the proposed structural and operational enhancements.

This research design allowed the research to assess the current implementation of ICS, identify gaps and challenges in emergency response, and develop a context-specific framework intended to improve role clarity, chain of command, coordination, resource mobilization, communication, environmental management, and overall emergency response capability at Bicol Airport.

A hypothetical on-airport commercial aircraft crash scenario was also developed as a supplementary illustration of the proposed Enhanced ICS Framework. The scenario involves aircraft fire, passenger injuries, aviation fuel leakage, and localized soil contamination. It illustrates the intended coordination of life-saving operations, environmental technical support, and external environmental assistance when required. The scenario was not used as a data-gathering instrument or a basis for assessment scores, and no simulation or operational testing of the framework was conducted. The proposed enhancements remain based on the findings of the document analysis, ARFF personnel survey, and key informant interviews.

Sources of Data

The study utilized both primary and secondary sources of data relevant to the enhancement of the Incident Command System (ICS) for Commercial Aircraft Accident Management at Bicol Airport.

Secondary data were obtained through the review and analysis of the Bicol Airport Aerodrome Emergency Plan (AEP), which served as the primary document for assessing the existing ICS arrangements and emergency response provisions of the airport. The document analyzed was the Bicol Airport – Aerodrome Emergency Plan, CAAP-AC5-RPLK-AEP v1 r0, dated March 27, 2026. The AEP was examined in relation to skills training, resource allocation and mobilization, interagency coordination and collaboration, environmental management integration, ICS organizational structure, communication procedures, and operational response procedures. Relevant provisions of applicable national and international standards and guidelines were also considered in interpreting the document-analysis findings and developing the proposed framework.

Primary data were gathered through a survey questionnaire and key informant interviews. The survey questionnaire was initially intended to obtain preparedness information from personnel of the identified airport response units. During the conduct of the study, differences in the operational responsibilities and emergency exercise experience of the response units were considered in determining the appropriate respondents. The quantitative survey was administered to twenty-seven (27) operational

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ARFF personnel because of their frontline responsibilities in aircraft emergency response and their relevant experience in airport emergency drills, simulations, and ICS-related training. However, participation in these general preparedness activities was distinguished from participation in a joint on-airport commercial aircraft crash drill or actual incident. All 27 ARFF respondents answered "No" to the questionnaire's screening question concerning such joint participation. Accordingly, the conditional items requiring that specific experience were excluded from the quantitative analysis. The preparedness and operational perspectives of the PNP-AVSEU, CSIS, and Medical Unit were obtained through key informant interviews with their respective unit heads.

Key informant interviews were conducted with the heads of the ARFF Unit, Philippine National Police – Aviation Security Unit (PNP-AVSEU), Civil Security and Intelligence Service (CSIS), and Medical Unit. The interviews provided qualitative information regarding existing policies, standards, practices, preparedness, operational procedures, coordination mechanisms, resource requirements, challenges, and recommendations related to commercial aircraft accident management.

The findings obtained from the document analysis, ARFF survey, and key informant interviews were integrated and triangulated to provide a comprehensive assessment of the current implementation of ICS at Bicol Airport and to serve as the basis for developing the proposed Enhanced Incident Command System Framework.

Population and Sampling

The study participants consisted of twenty-seven (27) operational ARFF personnel who served as survey respondents and four (4) selected unit heads from the ARFF Unit, Philippine National Police– Aviation Security Unit (PNP-AVSEU), Civil Security and Intelligence Service (CSIS), and Medical Unit who served as key informants.

Purposive sampling was employed in selecting the study participants based on their roles, responsibilities, and involvement in emergency response and coordination at Bicol Airport. The twenty-seven (27) operational ARFF personnel were included as survey respondents because ARFF serves as a primary frontline response unit during aircraft emergencies and has direct responsibilities in rescue, firefighting, and related emergency response activities. Their experience in airport emergency preparedness activities, including drills, simulations, and training, provided a relevant basis for assessing their perceived preparedness. However, this experience did not necessarily constitute participation in a joint on-airport commercial aircraft crash drill or actual incident, which was separately addressed through a screening question in the survey instrument.

The demographic profile of the twenty-seven (27) ARFF survey respondents, including their age, sex, position, and years of service:

Demographic Profile of Survey Respondents. The profile shows that the respondents represented different operational positions within the ARFF Unit, with the majority aged 41 years and above (55.56%) and having four years or more of service (81.48%). All respondents were male, while Firefighter I personnel comprised the largest group (51.85%). These characteristics provide context regarding the respondents' professional backgrounds and operational experience, which are relevant in interpreting their assessments of ICS awareness, preparedness, and emergency response responsibilities.

The survey was limited to the twenty-seven (27) ARFF personnel assigned to operational duty stations. Although other ARFF personnel assigned to designated or administrative functions may be mobilized during major emergencies to provide augmentation or perform Incident Command System (ICS) or Emergency Operations Center (EOC)-related functions, they were not included as survey respondents because the quantitative assessment focused on operational, field-level preparedness and ICS implementation.

The heads of the ARFF Unit, PNP-AVSEU, CSIS, and Medical Unit were purposively selected as key informants because of their supervisory responsibilities, decision-making functions, operational

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knowledge, and involvement in emergency planning, coordination, and resource management. Their participation provided qualitative information that complemented the quantitative findings from the ARFF survey, particularly regarding aviation security, safety and emergency protocols, medical response, interagency coordination, resource requirements, and implementation challenges.

Thus, the study involved thirty-one (31) participants in total, consisting of twenty-seven (27) survey respondents and four (4) key informants.

Table 1. *Respondents of the Study*

Respondents	Population	Target Sample
ARFF Personnel	27	27
ARFF Unit Head	1	1(KI)
PNP-AVSEU Unit Head	1	1(KI)
CSIS Unit Head	1	1(KI)
Medical Unit Head	1	1(KI)
TOTAL	31	31

Instrumentation

The primary data collection instruments utilized in this study were a survey questionnaire, a key informant interview guide, and a document analysis tool.

The survey questionnaire was designed to assess the perceived level of preparedness of operational Aerodrome Rescue and Firefighting (ARFF) personnel based on Incident Command System (ICS) protocols. The questionnaire included items addressing ICS awareness and role clarity, organizational structure and chain of command, training and drill participation, resource availability and sufficiency, operational readiness, and coordination and communication. The questionnaire also included items concerning the respondents' demographic profile and categorical responses relevant to emergency preparedness.

A semi-structured key informant interview guide was developed to obtain qualitative information from the heads of the ARFF Unit, Philippine National Police – Aviation Security Unit (PNP-AVSEU), Civil Security and Intelligence Service (CSIS), and Medical Unit. The interview questions focused on existing policies and practices, preparedness, operational procedures, coordination mechanisms, resource requirements, challenges encountered in ICS implementation, and recommendations for improving commercial aircraft accident management at Bicol Airport.

A document analysis tool was utilized to systematically examine the Bicol Airport Aerodrome Emergency Plan (AEP). The tool assessed the extent to which the provisions of the AEP were aligned with the identified ICS-related requirements and areas of the study, including skills training, resource allocation and mobilization, interagency coordination and collaboration, environmental management integration, ICS organizational structure, communication procedures, and operational response procedures. Communication procedures and operational response procedures were included as additional analytical components to provide a more detailed assessment of the AEP's provisions supporting ICS implementation.

The contents of the survey questionnaire, interview guide, and document analysis tool were developed based on the objectives of the study, principles of the Incident Command System, and relevant standards and guidelines issued by the International Civil Aviation Organization (ICAO), Civil Aviation Authority of the Philippines (CAAP), and National Disaster Risk Reduction and Management Council (NDRRMC).

Validation of Research Instrument

The survey questionnaire, key informant interview guide, and document analysis tool were validated to ensure their relevance, clarity, and alignment with the objectives of the study.

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The draft instruments were reviewed and validated by the Officer In-Charge of Bicol Airport, Mr. Roland N. Bocito, and the Safety and Quality Management Office (SQMO) In-Charge, Mr. Richard M. Nanson. The validators possess knowledge and experience relevant to airport operations, emergency management, and aviation safety.

The validators examined the content, structure, clarity, and applicability of the instruments in relation to the assessment of Incident Command System (ICS) implementation and commercial aircraft accident management at Bicol Airport. Their feedback, proposals, and advice were taken into account in the modification and enhancement of the tools before their implementation.

The validation process helped ensure that the research instruments adequately addressed the objectives of the study and were appropriate for gathering data relevant to the assessment and enhancement of the Incident Command System for commercial aircraft accident management at Bicol Airport.

Measures for Quantitative Data Analysis

The quantitative data obtained from the survey questionnaire administered to the twenty-seven (27) operational ARFF personnel were analyzed using frequency counts, percentages, and weighted means.

Frequency counts and percentages were used to summarize the respondents' demographic profile, participation in drills and simulations, frequency of ICS-related training, availability and sufficiency of resources, and other categorical responses.

Weighted means were computed for the Likert-scale items measuring respondents' perceptions of ICS awareness, role clarity, organizational structure and chain of command, operational readiness, interagency coordination, and related preparedness indicators.

The questionnaire also contained conditional items concerning unified command, interagency coordination, communication, and ICS planning and operational processes. These items were intended for respondents whose units had participated in a joint on-airport commercial aircraft crash drill or actual incident. Since all 27 respondents answered "No" to the corresponding screening question, the conditional items were not answered in accordance with the questionnaire instructions and were excluded from the quantitative analysis. Consequently, the study did not generate survey-based ratings of the effectiveness of these specific operational arrangements during joint aircraft crash response.

A five-point Likert scale was employed and understood in the following manner:

Table 2. *Interpretation of Ratings*

Rating Scale	Range	Interpretation
5	4.50 – 5.00	Strongly Agree
4	3.50 – 4.49	Agree
3	2.50 – 3.49	Neutral
2	1.50 – 2.49	Disagree
1	1.00 – 1.49	Strongly Disagree

For preparedness-related items, higher weighted mean scores indicated a higher level of perceived preparedness. The verbal interpretation of the Likert-scale items was based on the agreement scale presented in Table 2. Thus, weighted mean scores from 4.50 to 5.00 were interpreted as Strongly Agree, 3.50 to 4.49 as Agree, 2.50 to 3.49 as Neutral, 1.50 to 2.49 as Disagree, and 1.00 to 1.49 as Strongly Disagree.

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The document analysis was evaluated using a three-point alignment scoring rubric:

Table 3. *Document Analysis Scoring Rubric*

Score	Interpretation
2	Comprehensive
1	Partially Comprehensive
0	Not Addressed

The document analysis scores were assigned based on the extent to which the Bicol Airport Aerodrome Emergency Plan (AEP) addressed the seven selected ICS-related components assessed in this study. A score of 2 (Comprehensive) indicated that the AEP contained provisions addressing the component in relation to the assessment criteria. A score of 1 (Partially Comprehensive) indicated that the component was addressed but required further clarification or improvement. A score of 0 (Not Addressed) indicated that no explicit provision addressing the component was identified in the AEP reviewed. The scores were summarized, and the mean was computed by dividing the total score by the number of components assessed. The results were used to identify areas for enhancement and were not interpreted as a direct measure of overall airport preparedness.

Qualitative information gathered from the open-ended survey responses and key informant interviews was examined using thematic analysis. Responses were reviewed, coded, categorized, and grouped into recurring themes relating to operational practices, preparedness, resource requirements, coordination mechanisms, communication, organizational issues, environmental management, challenges, and recommendations.

The quantitative findings, qualitative findings, and document-analysis results were subsequently integrated through triangulation to provide a comprehensive basis for developing the proposed Enhanced ICS Framework.

Data Gathering Procedures

Prior to data collection, the researcher secured the necessary approval and authorization from the management of Bicol Airport to conduct the study.

Upon approval, the researcher reviewed the Bicol Airport Aerodrome Emergency Plan (AEP) and relevant reference materials applicable to the assessment of ICS implementation and commercial aircraft crash management. The AEP was systematically assessed using the document analysis tool to determine the extent to which its provisions addressed the identified ICS-related areas.

The survey instrument was originally designed to gather preparedness information from personnel of the designated airport response units. During the conduct of the study, the operational responsibilities and relevant emergency exercise experience of the response units were considered in determining the survey respondents. The quantitative survey was administered to twenty-seven (27) operational ARFF personnel, whose frontline responsibilities and involvement in airport emergency preparedness activities provided a relevant basis for assessing their perceived preparedness. The survey also included a screening question concerning participation in a joint on-airport commercial aircraft crash drill or actual incident. Since all respondents answered "No," the succeeding conditional items were skipped and excluded from the quantitative analysis. Key informant interviews were conducted with the heads of ARFF, PNP-AVSEU, CSIS, and the Medical Unit to obtain complementary information regarding their respective operational arrangements, preparedness, coordination mechanisms, and implementation challenges.

The survey respondents were informed of the purpose of the study and the manner in which the data would be used. The finalized surveys were gathered and arranged for quantitative evaluation.

Key informant interviews were conducted with the heads of the ARFF Unit, Philippine National Police – Aviation Security Unit (PNP-AVSEU), Civil Security and Intelligence Service (CSIS), and Medical Unit. The interviews followed a semi-structured guide and focused on current emergency response

practices, preparedness, coordination mechanisms, operational challenges, resource requirements, and recommendations for improving ICS implementation during commercial aircraft crashes.

No specifically designated Incident Management Team (IMT) personnel had been established at Bicol Airport. Consequently, a separate key informant interview with designated IMT personnel could not be conducted. The study instead gathered operational perspectives from the heads of the identified airport response units. This organizational condition was considered in identifying gaps and areas for enhancement in the proposed Enhanced Incident Command System Framework.

Upon completion of data collection, the survey responses were aggregated and examined by descriptive statistical techniques. The interview responses were coded and organized into themes, while the results of the document analysis were summarized according to the established alignment scoring rubric.

The findings from the three data sources were then synthesized and triangulated. The identified strengths, gaps, challenges, and operational requirements served as the basis for developing the proposed Enhanced Incident Command System Framework for Commercial Aircraft Accident Management at Bicol Airport.

Ethical Considerations

Before gathering data, the researcher obtained authorization from the management of Bicol Airport to carry out the study (see Appendix A: Permit to Conduct Study). Participation in the survey and key informant interviews was voluntary. Participants were informed of the purpose of the study and the nature of their participation before providing consent.

Confidentiality of information gathered from the participants was maintained throughout the study. The identities of individual respondents were not disclosed in the presentation of the findings. Information obtained from the survey and interviews was used solely for academic and research purposes.

The researcher also ensured that the data were presented objectively and accurately and that the findings were reported based on the information obtained from the respondents, key informants, and reviewed documents.

The researcher further complied with the applicable ethical requirements for conducting the study, as reflected in the Ethical Compliance Checklist (see Appendix B: Ethical Compliance Checklist).

RESULTS

The first objective of the study was to examine the existing policies, standards, practices, and protocols governing the implementation of the Incident Command System (ICS) for commercial aircraft crash management at Bicol Airport. This objective was achieved through a comprehensive document analysis of the Bicol Airport Aerodrome Emergency Plan (AEP), which serves as the primary airport emergency response document prescribing the organizational structure, operational procedures, roles and responsibilities, communication protocols, and coordination mechanisms during airport emergencies.

The Aerodrome Emergency Plan was evaluated using the researcher – developed Document Analysis Tool, which assessed the document based on key Incident Command System components, namely: skills training of emergency response personnel, resource allocation and mobilization, interagency collaboration and coordination, environmental management integration, organizational structure, communication procedures, and operational response procedures. The document was further assessed using an ICS alignment scoring rubric to determine the extent to which its provisions conform to established Incident Command System principles.

To complement and corroborate the document analysis, key informant interviews were conducted with the heads of the Aerodrome Rescue and Firefighting (ARFF) Unit, Civil Security and Intelligence Service (CSIS), Medical Unit, and Philippine National Police–Aviation Security Unit (PNP-AVSEU). Their responses provided operational perspectives on the implementation of existing policies and procedures and helped explain how the provisions contained in the Aerodrome Emergency Plan are understood and applied

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during drills, simulations, and emergency preparedness activities. The combined findings from the document analysis and key informant interviews provided a basis for assessing the existing ICS arrangements at Bicol Airport.

Table 4 shows the policies, standards, and emergency management practices found in the Bicol Airport Aerodrome Emergency Plan (AEP) in relation to the implementation of the Incident Command System (ICS). The assessment covered the five areas identified in the first research objective: skills training of emergency response personnel, resource allocation and mobilization, interagency coordination and collaboration, environmental management integration, and ICS organizational structure. Communication procedures and operational response procedures were also examined as supplementary components to provide a more detailed assessment of the AEP's provisions supporting ICS implementation. It also identified the relevant sections of the AEP and describes how each area is addressed in the document.

Table 4. *Existing Policies, Standards, and Emergency Management Practices*

Variables	**Policies**	**Standards**	**Emergency Management Practices**
1.1 Skills training of emergency response employees	Section 1.10 (Training, Drills, and Exercises)	Sections 1.10.2.1–1.10.2.3 (Full-Scale, Partial, and Tabletop Exercises); Section 2.7.8 (ARFF Personnel Training)	Conduct of full-scale, partial, and tabletop exercises, as well as ARFF personnel training, in accordance with the procedures specified in the AEP.
1.2 Resource allocation and mobilization	Section 2.7 (ARFF Services); Section 2.8 (Medical Services); Section 2.6 (Law Enforcement/Security)	Section 2.7.3 (Assignment of Responsibilities); Section 2.7.4 (Communication Equipment); Section 2.7.7 (Vehicle Response Capabilities)	Assignment and deployment of ARFF, medical, and law enforcement/security personnel, including the utilization of communication equipment and emergency response vehicles in accordance with their designated functions.
1.3 Interagency coordination and collaboration	Section 1.7 (Organization and Assignment of Responsibilities)	Sections 1.7.1–1.7.2 (Organizational Responsibilities and Related Arrangements)	Section 3.3.1.7 (External Support Activation), providing for the activation of external support during emergencies.
1.4 Integration of Environmental Management into emergency procedures	No explicit provisions identified.	No explicit environmental management standards identified.	No explicit environmental response practices identified.
1.5 ICS Organizational Structure	Section 3.3.1.8–F3 (Incident Command System Structure)	Identification of ICS positions, organizational arrangements, and assigned command responsibilities, as specified in the AEP.	Implementation of the prescribed ICS organizational arrangements during emergency response, including the assignment of command functions and reporting relationships.

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Based on the document analysis, the AEP contains provisions for personnel training, the allocation and mobilization of emergency resources, coordination among responding agencies, and the organizational structure for emergency response. These provisions cover activities such as conducting full-scale, partial, and tabletop exercises; assigning responsibilities to emergency response units; activating external support when needed; and identifying ICS positions and their corresponding responsibilities. Together, these provisions provided guidance on how personnel and resources are organized and how responding units are expected to work together during aircraft emergencies.

However, the analysis found no specific provisions for integrating environmental management into the AEP's emergency procedures. The document does not explicitly discuss measures for managing fuel spills, containing hazardous materials, protecting the environment, conducting environmental recovery, or monitoring environmental conditions after an aircraft crash. This finding points to an area that needs further attention, particularly because aircraft crashes may also involve environmental hazards that require an appropriate response.

The importance of addressing this gap becomes more apparent when considering a hypothetical commercial aircraft crash involving fire, injured passengers, and an aviation fuel spill. While rescue and firefighting operations would remain the immediate priority, the incident could also require measures to contain fuel spills, assess possible soil contamination, and prevent further environmental damage. These activities would require clearly assigned responsibilities, the involvement of qualified environmental personnel when necessary, and coordination with appropriate external responders. Including these arrangements in the AEP would help ensure that

environmental concerns are considered alongside other emergency response priorities.

It should be noted that the presence of a provision in the AEP does not necessarily mean that the corresponding ICS component is adequately covered. For this reason, Table 5 examines the extent to which the identified provisions address each component using the scoring rubric established for the study.

Table 5. *Document Analysis of the Bicol Airport Aerodrome Emergency Plan Based on ICS Components*

ICS Component	Score	Interpretation	Remarks
Skills Training	2	Comprehensive	Training, tabletop, partial and full-scale exercises are specified.
Resource Allocation and Mobilization	2	Comprehensive	Resources, communication equipment, vehicles, medical services and law enforcement responsibilities are defined.
Communication Procedures	2	Comprehensive	Communication and notification procedures are clearly established.
Operational Response Procedures	2	Comprehensive	Standard operating procedures for aircraft crash response are provided.
Interagency Coordination	2	Comprehensive	External support activation and agency responsibilities are clearly identified.

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ICS Component	Score	Interpretation	Remarks
Organizational Structure	1	Partially Comprehensive	The ICS organizational structure is present, but its relationship with the EOC structure is not clearly distinguished, and overlapping roles are identified.
Environmental Management Integration	0	Not Addressed	No explicit environmental management provisions were identified.

Table 5 presents the results of the document analysis conducted on the Bicol Airport Aerodrome Emergency Plan (AEP) using seven components of the Incident Command System (ICS). The results show that five components, namely skills training, resource allocation and mobilization, communication procedures, operational response procedures, and interagency coordination, received a rating of 2, interpreted as Comprehensive. Organizational Structure received a rating of 1, interpreted as Partially Comprehensive, while Environmental Management Integration received a rating of 0, interpreted as Not Addressed. The overall mean score was 1.57.

The findings showed that the AEP covers most of the essential components of airport emergency preparedness and response. It provides provisions for personnel training, resource arrangements, communication, operational procedures, and coordination among responding agencies. However, the analysis also identified areas that need further attention, particularly the organizational structure of the ICS and the integration of environmental management into emergency response arrangements.

The comprehensive ratings of the five components indicated that the AEP provides a documented basis for organizing and carrying out emergency response activities. Its provisions on training and exercises outline arrangements for preparing personnel for emergency situations. It also identifies the responsibilities of responding units, the use of emergency resources and equipment, communication arrangements, and procedures for operational response. In addition, the plan provides mechanisms for coordinating with participating agencies and requesting external support when necessary. These provisions are important in ensuring that the different units and agencies have established responsibilities and procedures to follow during an airport emergency.

Despite these provisions, the organizational structure requires further clarification. Although the AEP identifies ICS positions and organizational arrangements, the relationship between the Incident Management Team (IMT) and the Emergency Operations Center (EOC), including their respective functions and reporting arrangements, needs to be more clearly defined. Another concern is the concurrent designation of the Incident Commander (IC) as the Operations Section Chief. Assigning both functions to one person may result in overlapping responsibilities, particularly during major incidents that require continuous command and supervision of response operations. These findings indicated the need to establish clearer command relationships and distinguish the incident management functions from the coordination and support functions of the EOC.

The absence of explicit environmental management provisions is another important finding. The AEP does not specifically address environmental concerns that may arise during commercial aircraft crashes, such as fuel spills, hazardous materials, and other conditions that could affect the surrounding environment. Although the plan provides arrangements for emergency response activities, the lack of specific environmental provisions leaves a gap in defining responsibilities and procedures for addressing these concerns. Environmental management should therefore be incorporated into the emergency response arrangements, including the involvement of qualified technical personnel and coordination with appropriate environmental authorities when necessary.

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The findings suggested that the existing AEP provides a foundation that can be strengthened to improve ICS implementation at Bicol Airport. The provisions already established in the plan can be retained while addressing the identified gaps in organizational structure and environmental management. In particular, the command and reporting relationships should be clarified, the respective functions of the IMT and EOC should be defined, and environmental response arrangements should be included. These improvements would help make the existing emergency management arrangements more complete and responsive to the requirements of commercial aircraft crash management.

Personnel Preparedness Based on ICS Protocols

This section presents the level of preparedness of Bicol Airport personnel based on the Incident Command System (ICS) protocols during for on-airport commercial aircraft crash response. Quantitative data were obtained through the survey administered to the 27 Aerodrome Rescue and Firefighting (ARFF) personnel, while qualitative findings from the key informant interviews with the heads of the ARFF, Civil Security and Intelligence Service (CSIS), Medical Unit, and Philippine National Police–Aviation Security Unit (PNP-AVSEU) were used to complement and provide context to the survey results. The findings are organized according to the operational areas identified in the study.

Aerodrome Rescue and Firefighting Operations

The assessment of ARFF personnel's preparedness begins with their demographic profile, which provides background on the respondents in terms of age, sex, position, and years of service. These characteristics help describe the group whose perceptions and experiences form the basis of the survey findings. The demographic profile of the twenty-seven (27) ARFF respondents is presented in Appendix F.

Their preparedness was assessed based on their knowledge of the Incident Command System (ICS) organizational structure and chain of command, participation in emergency exercises, frequency of ICS-related training, confidence in performing assigned duties, and the availability and sufficiency of emergency response resources. These indicators were used to determine how prepared ARFF personnel consider themselves to be in carrying out their responsibilities during an on-airport commercial aircraft crash. Responses to the preparedness-related statements were measured using a five-point Likert scale, with higher weighted mean values indicating stronger agreement and a higher level of perceived preparedness. The results are presented in Tables 6 and 7, while additional findings on training, confidence, and resources are provided in Appendices G, H, and I, respectively. The survey findings are further supported by the interview with the ARFF Unit Head.

Table 6 presents the level of preparedness of ARFF personnel in terms of their awareness of the ICS organizational structure and chain of command. The overall weighted mean of 4.87, interpreted as Strongly Agree based on the rating scale in Table 2, shows that respondents generally have a high level of awareness of the command structure and reporting arrangements followed during aircraft emergency response activities at Bicol Airport.

Among the indicators, understanding of assigned roles and responsibilities received the highest weighted mean of 5.00, showing that all respondents strongly agreed with the statement. This was followed by the clarity of the designated Incident Commander and established command authority, with a weighted mean of 4.93. Familiarity with the chain of command and decision-making authority received 4.85, while awareness of the ICS organizational structure obtained 4.70. These results suggest that ARFF personnel are particularly familiar with their individual duties and the authority structure that guides their work during an emergency.

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Table 6. *Preparedness in Terms of ICS Organizational Structure and Chain of Command*

Indicator	Weighted Mean	Interpretation
I am aware of the ICS organizational structure and chain of command used during on-airport commercial aircraft crash response/ drills/simulation exercises at Bicol Airport.	4.70	Strongly Agree
I clearly understand my role and responsibilities during on-airport commercial aircraft crash response/drills/simulation exercises at Bicol Airport.	5.00	Strongly Agree
I am familiar with the chain of command and decision-making authority during on-airport commercial aircraft crash response operations/drills/simulation exercises at Bicol Airport.	4.85	Strongly Agree
There is a designated Incident Commander, and command authority is clearly established during on-airport commercial aircraft crash response operations/drills/simulation exercises at Bicol Airport.	4.93	Strongly Agree
Overall Mean	4.87	Strongly Agree

The interview with the ARFF Unit Head provides further support for these results. The Unit Head rated the preparedness of ARFF personnel at approximately 8 out of 10 and attributed this to their regular operational activities, tabletop exercises, partial emergency exercises, and recurrent training. The respondent also explained that personnel are familiar with their assigned duties because these are discussed and communicated during training and actual operational activities. This suggests that regular exposure to emergency procedures helps personnel understand their responsibilities and the actions expected of them during an emergency.

Table 7. *Frequency of Participation in Drills, Simulations, and Emergency Exercises*

Response	Frequency	Percentage
Always	21	77.78
Often	6	22.22
Sometimes	0	0.00
Rarely	0	0.00
Never	0	0.00
Total	27	100.00

Participation in emergency exercises is another important part of preparedness because it allows personnel to practice their duties and become more familiar with emergency procedures. As shown in Table 7, 21 respondents (77.78%) reported that they always participate in drills, simulations, and emergency preparedness activities conducted within their unit, while six (22.22%) reported that they often participate. This indicates that ARFF personnel regularly take part in activities intended to maintaintheir operational readiness.

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However, a different result emerged from the separate screening question on participation in joint on-airport commercial aircraft crash drills or actual incidents involving other airport response units. All 27 respondents answered no. This means that while personnel regularly participate in activities within their own unit, they have not had the same opportunity to take part in exercises or actual incidents involving the coordinated participation of other airport response units.

This finding was also confirmed by the ARFF Unit Head, who explained that personnel regularly undergo operational drills, tabletop exercises, and recurrent training. However, a full-scale aircraft crash exercise involving the different airport response units has not yet been conducted at Bicol Airport. Although these activities allow ARFF personnel to practice their individual and unit-level responsibilities, they do not fully replicate the coordination required during an actual aircraft crash involving several responding units. Joint exercises are therefore necessary to give personnel the opportunity to apply their knowledge of ICS, follow established command relationships, and coordinate their actions with other responders.

The frequency of ICS-related training also provides an indication of how personnel maintain their preparedness (see Appendix G: Frequency of Receipt of Incident Command System (ICS) Training). Twenty-five respondents (92.60%) reported receiving ICS-related training once a year. One respondent (3.70%) reported receiving training more than twice a year, while another respondent (3.70%) indicated that they had never received such training. The results showed that annual training is the usual practice among the respondents. These sessions provide opportunities to review emergency procedures, refresh knowledge, and become familiar with assigned ICS functions. However, regular participation in training should be complemented by refresher sessions and practical exercises to help personnel retain and apply what they have learned. The ARFF Unit Head also recommended more frequent refresher training and the eventual conduct of full-scale aircraft crash exercises to further develop personnel competence and operational capability.

Another indicator considered was the confidence of personnel in performing their assigned ICS duties . Eighteen respondents (66.67%) reported a very high level of confidence, eight (29.63%) reported a high level of confidence, and only one (3.70%) reported a moderate level of confidence. This indicated that most ARFF personnel feel capable of carrying out their assigned responsibilities during aircraft crash response activities. Their confidence may be related to their familiarity with emergency procedures, operational experience, and exposure to training and exercises. In general, personnel who understand their duties and feel capable of performing them are more likely to perceive themselves as prepared. Still, confidence should not be treated as proof of actual operational competence. Personnel must also be given adequate training and opportunities to demonstrate their abilities during emergency exercises.

The availability and sufficiency of emergency response resources are equally important because personnel need the necessary equipment and support to perform their assigned functions (see Appendix I: Availability and Sufficiency of Resources and Equipment for On-Airport Commercial Aircraft Crash Response). All 27 respondents (100.00%) indicated that the necessary resources and equipment were available to their unit during emergency response operations and drills. However, only two respondents (7.41%) considered these resources sufficient for an effective response, while 25 (92.59%) indicated that they were insufficient. This distinction is important: having resources available does not necessarily mean that the quantity or capability of those resources is adequate for a major commercial aircraft crash.

The respondents identified several resource needs, including additional manpower, rescue personnel, ambulances, professional medical support, heavy equipment, and specialized rescue tools. The ARFF Unit Head also raised manpower as a major operational concern, particularly during rescue and retrieval operations in large-scale emergencies. These responses suggested that the resources currently available may support initial response activities but may not be enough to meet all the demands of a major aircraft crash. Preparedness, therefore, involves not only having knowledgeable and confident personnel but also ensuring that they have sufficient resources to carry out their responsibilities.

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The document analysis of the Bicol Airport Aerodrome Emergency Plan (AEP) provides additional context for these findings. The plan contains provisions on the ICS organizational structure, personnel responsibilities, communication procedures, training, and emergency exercises. It also identified the responsibilities of ARFF, Medical Services, Law Enforcement/Security, and other supporting agencies, including arrangements related to resource allocation and mobilization. These provisions provide an established basis for organizing and preparing the airport's emergency response personnel. However, the survey findings showed that having these arrangements documented does not automatically mean that personnel have already experienced joint aircraft crash exercises or that available resources are sufficient for a major incident.

Taken together, the findings showed that ARFF personnel have a high level of perceived preparedness, particularly in their understanding of the ICS organizational structure, chain of command, and assigned responsibilities. Their regular participation in unit-level activities, annual ICS-related training, and generally high confidence also contribute to this assessment. At the same time, the results point to areas that still need attention. Although personnel are familiar with their individual duties, they have not participated in joint aircraft crash exercises with other airport response units. In addition, most respondents consider the available resources insufficient for an effective response. These findings indicate that individual and unit-level preparedness provides a good starting point, but further improvements are needed to support a coordinated response to a major commercial aircraft crash.

Aviation Security Measures

The preparedness of Bicol Airport in terms of aviation security measures was assessed through interviews with the heads of the Civil Security and Intelligence Service (CSIS) and the Philippine National Police–Aviation Security Unit (PNP-AVSEU). The interviews covered their units' preparedness, assigned responsibilities, personnel training, communication and coordination, available resources, challenges, and suggestions for improving aviation security during commercial aircraft crash emergencies. Since personnel from these units had not participated in an on-airport commercial aircraft crash drill requiring the full implementation of the Incident Command System (ICS), the assessment was based on the experiences and observations shared by the two key informants.

Both key informants (2 out of 2) expressed confidence in their respective units' ability to perform their security functions during an aircraft crash emergency. However, they described their level of preparedness differently. The CSIS Head rated the unit's preparedness as Level 1, explaining that the unit had not experienced significant security threats or an actual aircraft crash requiring full emergency activation. Despite this, the respondent was confident that personnel could carry out their duties, particularly crowd control, access control, and ground security, since these are already part of their regular airport operations. The PNP-AVSEU Head, on the other hand, described the unit as fully prepared and pointed to personnel training in crisis management and aviation security operations as the basis for this assessment. Their responses show that both units are confident in their ability to perform their assigned functions, although this confidence is largely based on routine operations and existing training rather than experience in a major aircraft crash response.

When asked about their operational responsibilities, both key informants (2 out of 2) explained that their personnel have established duties in maintaining airport safety and security during emergencies. The CSIS Head shared that personnel have completed Basic Aviation Security (Basic AVSEC) training and continue to perform their security functions regardless of the type of airport emergency. Similarly, the PNP-AVSEU Head explained that personnel undergo crisis management training before deployment and are assigned specific responsibilities for maintaining airport security. This shows that the two units have an established understanding of their respective roles, particularly in controlling access, managing crowds, maintaining ground security, and supporting emergency operations.

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Communication was another area discussed by both informants (2 out of 2). They identified radio communication and mobile phones as the primary means of coordinating with other responding units and agencies. The PNP-AVSEU Head (1 out of 2) also discussed the importance of preparing personnel through tabletop discussions, communication exercises, and simulation exercises. According to the respondent, these activities help familiarize responders with their responsibilities and improve coordination before an actual emergency takes place. While the two units already have communication channels available, their effectiveness during a major aircraft crash involving several airport response units still needs to be assessed through joint exercises under the ICS.

In terms of resources, both Key Informants (2 out of 2) considered the equipment available to their respective units generally sufficient for carrying out their assigned security functions. The CSIS Head mentioned crowd control materials, such as caution tape and traffic cones, as adequate for the unit's operational needs. The PNP-AVSEU Head also considered the resources available to the unit sufficient for its security responsibilities. However, the PNP-AVSEU Head (1 out of 2) pointed out that funding remains a concern, particularly when conducting simulation exercises and other emergency preparedness activities. The respondent recommended additional investment in resources such as ambulances, communication equipment, transport vehicles, and medical support personnel. This distinction is important because the resources considered sufficient for routine security functions may not necessarily cover the additional requirements of a large-scale aircraft crash.

The informants also shared several suggestions for improving their units' preparedness. The CSIS Head (1 out of 2) recommended conducting orientation sessions and tabletop exercises before emergency drills. The respondent also suggested including Job Order personnel in ICS-related training so they would understand their responsibilities during an emergency. Meanwhile, the PNP-AVSEU Head (1 out of 2) emphasized the need for continuing seminars, refresher training, and skills enhancement activities to maintain personnel competency. The respondent also raised concerns about communication reliability, noting that communication failures could delay emergency response operations. Additional funding was likewise recommended to support preparedness activities and improve available resources. Although their recommendations focused on different areas, both informants recognized that personnel preparedness requires continuing attention and improvement.

Overall, the interviews revealed that CSIS and PNP-AVSEU have an established foundation for performing their aviation security responsibilities. Both key informants (2 out of 2) expressed confidence in their personnel, identified established operational duties, and described the communication channels used by their units. They also considered their available resources generally sufficient for their respective security functions. However, the interviews brought out concerns that need to be addressed, particularly funding limitations, communication reliability, and the need for more regular exercises and broader ICS orientation. More importantly, the two units have not yet demonstrated their ability to work with other airport response units during a joint commercial aircraft crash exercise requiring full ICS implementation. Their preparedness is therefore evident in their existing security arrangements, but their coordination within a larger airport emergency response operation still needs to be practiced and evaluated.

Enforcement of Safety and Emergency Protocols

The enforcement of safety and emergency protocols at Bicol Airport was assessed through key informant interviews with the heads of the Aerodrome Rescue and Firefighting (ARFF), Philippine National Police–Aviation Security Unit (PNP-AVSEU), Civil Security and Intelligence Service (CSIS), and Medical Team. The interviews focused on how each unit carries out its assigned responsibilities, follows established emergency procedures, and applies the principles of the Incident Command System (ICS) during on-airport commercial aircraft crash response. The assessment also considered the challenges experienced by the units and the improvements they believe are necessary to strengthen emergency response operations.

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The interview results showed that all four key informants (4 out of 4) described existing procedures that guide their respective units during airport emergencies. Although their operational responsibilities differ, the respondents explained that personnel are expected to perform their assigned functions in accordance with established unit procedures and the Bicol Airport Aerodrome Emergency Plan (AEP). This indicates that the airport has existing safety and emergency arrangements that provide guidance to the different responding units.

The ARFF Unit Head explained that firefighters follow established aircraft rescue and firefighting procedures and regularly participate in drills, in-house training, and operational exercises. These activities help personnel maintain familiarity with their duties and prepare them for emergency response operations. The respondent nevertheless emphasized that training and drills must be continued to maintain personnel readiness and identify areas that may need improvement.

The PNP-AVSEU Head also reported that aviation security personnel follow established security guidelines and crisis management procedures. The respondent expressed confidence in the personnel's understanding of their responsibilities and reported that ICS principles are applied within the unit. However, the interview also brought up concerns regarding the reliability of communication systems and limited funding for training and simulation exercises. These concerns may affect the unit's ability to sustain its preparedness activities and coordinate effectively during emergencies.

The CSIS Head similarly explained that personnel carry out their assigned functions, particularly crowd control, access control, and securing restricted areas during emergencies. The respondent considered personnel familiar with their security responsibilities and described coordination with other responding units as generally effective. However, the formal application of ICS principles within the unit remains limited, as personnel primarily rely on established security procedures and instructions from the Incident Commander. The respondent also recommended providing ICS training and orientation to Job Order personnel and conducting briefings before emergency drills to improve their understanding of their respective responsibilities.

The Medical Team presented a different concern. Although medical personnel are capable of providing initial emergency medical care based on their professional training, the Medical Unit Head acknowledged that the unit's specific roles under ICS have not yet been fully defined and that ICS principles are not consistently applied during emergency operations. The respondent also identified the absence of full-scale aircraft crash exercises, limited opportunities for specialized training, and the lack of detailed standard operating procedures specifically addressing medical response during commercial aircraft crashes. These concerns pointed to the need for clearer medical response arrangements and more opportunities for personnel to practice their functions within the airport's overall emergency response structure.

A comparison of the interviews shows that the four units have different levels of reported familiarity with and application of ICS. Two key informants (2 out of 4), representing ARFF and PNP-AVSEU, described a higher level of familiarity with ICS implementation within their respective units. In contrast, the other two key informants (2 out of 4), representing CSIS and the Medical Team, acknowledged limitations in the formal or consistent application of ICS. This difference is important because having established procedures within each unit does not automatically mean that all units apply ICS in the same way. The findings point to the need for a more consistent understanding of command relationships, assigned ICS functions, and coordination arrangements across the airport response organization.

These observations are also related to the document analysis presented under Objective 1. The AEP identifies an ICS organizational structure and provides guidance on the responsibilities of responding units. However, the document analysis also identified areas requiring further clarification, particularly the relationship between ICS and Emergency Operations Center (EOC) functions and the assignment of overlapping responsibilities. The interview findings provided additional context to these documentary observations. While the AEP establishes arrangements for emergency response, the accounts of the CSIS and Medical Team Heads show that some units still need clearer guidance on how their functions fit within

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the ICS structure. This suggested that the issue is not simply the absence of emergency procedures but the need to ensure that the established arrangements are clearly understood and consistently applied by all responding units.

Taken together, the major findings showed that all four units have established operational procedures and assigned responsibilities for responding to airport emergencies. However, their reported application of ICS differs. ARFF and PNP-AVSEU described greater familiarity with ICS implementation, while CSIS and the Medical Team identified areas where its application remains incomplete. The interviews also brought out the need for continuing training, clearer unit-specific guidance, regular multi-agency exercises, and improved organizational coordination. These findings indicate that Bicol Airport has an existing foundation for enforcing safety and emergency protocols, but further work is needed to ensure that the different units can carry out their responsibilities within a common command and coordination structure.

Medical Emergency Response

Medical emergency response preparedness at Bicol Airport was assessed through an interview with the Medical Unit Head. The interview covered the qualifications of medical personnel, availability of medical resources, coordination with other responding agencies, application of Incident Command System (ICS) principles, and difficulties encountered during airport emergencies. It also examined the Medical Team's ability to provide medical assistance during an on-airport commercial aircraft crash, particularly in situations involving several casualties.

Based on the interview, the Medical Team has personnel with the necessary qualifications to provide initial emergency medical care. The Medical Unit Head explained that all three airport nurses have completed Basic Life Support (BLS) training, one nurse is a licensed Emergency Medical Technician (EMT), and the Unit Head has previously completed Advanced Life Support (ALS) training. These qualifications allow the team to provide first aid, attend to patients, and stabilize their condition before they are transferred to higher-level medical facilities. The respondent considered these skills important in handling medical emergencies within the airport.

Despite these qualifications, the Medical Unit Head identified manpower as one of the main concerns of the unit. The Medical Team has only three nurses, with one nurse assigned per shift, while the airport physician is available only on a scheduled basis. According to the respondent, this arrangement is manageable for routine passenger medical incidents but could become a problem during a major aircraft crash involving several injured passengers. With only one nurse on duty at a time, providing medical attention to multiple casualties would be difficult. This showed that the current staffing arrangement may be adequate for ordinary medical concerns but could be stretched during a large-scale emergency.

The interview also revealed gaps in training and emergency exercise experience. The Medical Unit Head shared that the team has not yet participated in a full-scale aircraft crash exercise. Previous drills have mainly involved fire and earthquake scenarios, while preparation for aircraft crash response has largely remained theoretical. Although one nurse has undergone ICS and Emergency Operations Center (EOC) training, not all medical personnel have received formal ICS training. The respondent explained that training opportunities are limited and are generally prioritized for permanent personnel. This means that while some members have received relevant training, the entire team has not yet had the same opportunity to become familiar with

ICS and its application during emergency operations. Regarding medical resources, the Medical Unit Head reported that the team has basic first aid equipment, oxygen tanks, spine boards, and transport capability for initial emergency response. These resources are generally sufficient for providing first aid and stabilizing patients. However, the respondent pointed out that they may not be enough during a major aircraft crash involving numerous casualties. Additional medical equipment, specialized resources, and more personnel were identified as necessary to improve the team's capacity. This distinction showed that

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having basic medical equipment available does not necessarily mean that the unit is fully equipped to handle a mass casualty incident.

Coordination with other responding agencies was generally described as effective. The Medical Unit Head explained that communication is usually initiated through official notifications before scheduled drills and through security personnel during actual emergencies. However, the respondent also identified communication as one of the unit's main operational concerns. Medical personnel do not have dedicated emergency radios and sometimes receive incomplete information about an incident before being deployed. Without sufficient information about the situation, the team may have difficulty determining what equipment and medical supplies to bring to the scene. This can affect their preparation and ability to provide an appropriate response upon arrival.

Another concern raised during the interview was the incomplete implementation of ICS within the Medical Team. Although personnel understand their general medical duties, the Medical Unit Head acknowledged that their specific ICS assignments, reporting relationships, and operational limits during aircraft crash response have not been fully established. The respondent also explained that ICS principles are not consistently applied during airport emergency operations. This may create confusion about who medical personnel should report to, how their activities should be coordinated with other responding units, and what responsibilities they are expected to perform within the overall command structure. The issue, therefore, is not simply whether medical personnel know how to provide emergency care, but also whether they understand how to perform their duties within the airport's ICS arrangements.

When asked about possible improvements, the Medical Unit Head recommended providing more ICS and EOC training opportunities for all medical personnel. The respondent also emphasized the need for greater participation in tabletop exercises and future full-scale exercises, as well as clearer standard operating procedures specifically for aircraft crash response. Improvements in communication equipment, manpower, and medical resources were also recommended. In addition, the respondent suggested working with external organizations, such as the Department of Health and the Philippine Red Cross, to provide specialized emergency medical training. These recommendations show that the team recognizes the need to strengthen not only its medical capabilities but also its role in the airport's overall emergency response system.

Overall, the interview revealed that the Medical Team has personnel with relevant qualifications and basic resources for providing initial emergency medical care. However, several limitations may affect its ability to respond to a major commercial aircraft crash. These include the small number of medical personnel, limited specialized training, lack of experience in full-scale aircraft crash exercises, and insufficient resources for managing multiple casualties. The interview also brought out concerns regarding communication and the lack of clearly defined ICS assignments and aircraft crash response procedures. Taken together, these results show that the team can handle routine medical emergencies, but its capacity for a large-scale aircraft crash still needs to be strengthened.

Interagency Coordination and Communication

Interagency coordination and communication at Bicol Airport were assessed through key informant interviews with the heads of the Aerodrome Rescue and Firefighting (ARFF), Philippine National Police–Aviation Security Unit (PNP-AVSEU), Civil Security and Intelligence Service (CSIS), and Medical Team. The interviews focused on how these units coordinate with one another, the communication methods they use, and the challenges they encounter during emergency drills, simulations, and other airport operations. Their responses provided the basis for examining the existing coordination arrangements and identifying areas that need improvement in preparation for on-airport commercial aircraft crash emergencies.

Based on the interviews, all four key informants (4 out of 4) recognized that good coordination and communication are necessary for an effective emergency response. They generally described the working relationship among airport units as satisfactory, particularly during routine emergencies and scheduled

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preparedness activities. Since Bicol Airport has not experienced an actual commercial aircraft crash, the respondents' assessments were based primarily on their experiences coordinating with other airport units during emergency drills involving different types of airport emergencies. These experiences provided the basis for describing the existing communication practices and coordination arrangements among the responding units. However, while these activities offer insights into how the units work together during emergency situations, they do not fully establish how the same arrangements would function during an actual commercial aircraft crash.

The ARFF Unit Head explained that coordination with other responding agencies takes place through tabletop exercises, formal communications, and radio operations. These activities allow personnel to discuss their responsibilities and become familiar with how other units carry out their tasks during an emergency. The respondent also stressed the importance of conducting regular drills, as these help personnel maintain their readiness and become more familiar with the communication procedures they need to follow.

The PNP-AVSEU Head shared a similar view but placed particular emphasis on the preparation that takes place before an exercise. According to the respondent, coordination usually begins with tabletop discussions, followed by communication exercises and simulation drills. Radios and mobile phones are commonly used to communicate with other responding units, and these are generally considered effective. However, the respondent pointed out that delays in passing information could affect the response of other agencies. The PNP-AVSEU Head therefore recommended improving radio capability and establishing more reliable group communication platforms so that important information can reach the concerned personnel without unnecessary delay.

The CSIS Head also described coordination with other airport units as generally effective. The unit uses radios and cellular phones to communicate, while established security procedures guide its personnel in handling crowd control and access management during emergencies. Although the respondent did not report major coordination problems in current operations, the CSIS Head raised the need to include Job Order (JO) personnel in ICS orientations and tabletop exercises. This is important because personnel who may be involved in emergency operations should understand their assigned responsibilities, regardless of their employment status.

For the Medical Team, coordination is generally carried out through official communications and advance notifications, especially before scheduled drills. However, the Medical Team Head explained that the information provided before deployment is not always complete. This can make it difficult for medical personnel to determine what equipment and supplies they need to prepare before proceeding to the incident area. The respondent also pointed out that the team does not have dedicated radio equipment and relies mainly on mobile phones for communication. During an emergency that requires an immediate response, these limitations could affect how quickly the team receives information and prepares for its assigned tasks.

Although the four-unit heads generally described coordination as effective, their responses also revealed concerns that need to be addressed. The PNP-AVSEU Head identified the possibility of delays in transmitting information, while the Medical Team Head raised concerns about incomplete incident details and the lack of dedicated radios. The CSIS Head, on the other hand, emphasized the need to involve JO personnel in ICS orientations and preparedness exercises. These responses suggested that the airport already has communication methods and coordination practices in place, but their reliability and consistent application still need to be strengthened.

Challenges Encountered in ICS Implementation

This objective identifies the challenges encountered by Bicol Airport in implementing the Incident Command System (ICS) during on-airport commercial aircraft accident response. The findings were derived from the open-ended responses of ARFF personnel and the key informant interviews conducted with the heads of the ARFF, PNP-AVSEU, CSIS, and Medical Team. Responses with similar content were sorted into common themes to determine the primary operational hurdles to adoption of the ICS.

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As shown in Table 8, six major challenges emerged from the findings: limited manpower, communication limitations, limited training and exercises, resource and equipment limitations, organizational and ICS implementation issues, and environmental management limitations. These challenges highlight the areas that need attention to improve the airport's ability to implement ICS and respond effectively to an on-airport commercial aircraft crash. Each theme is discussed in the following paragraphs.

The findings consistently identified manpower as one of the most significant challenges affecting ICS implementation. Most ARFF respondents indicated that additional rescue personnel are needed to manage mass-casualty situations resulting from on-airport commercial aircraft crashes. The ARFF Unit Head likewise explained that existing personnel may be insufficient during large-scale on-airport commercial aircraft crashes involving hundreds of passengers. Similar concerns were expressed by the Medical Team, which operates with only one nurse per shift, limiting its capacity to respond simultaneously to multiple casualties. These findings suggest that manpower limitations may affect response efficiency, casualty management, and operational sustainability during prolonged emergency operations.

Table 8. *Challenges Encountered in the Implementation of ICS*

Theme	Sources of Evidence	Description
Limited Manpower	ARFF Survey (n=22), ARFF Interview, Medical Interview	Insufficient rescue personnel and limited medical staffing during large-scale emergencies
Communication Limitations	ARFF Survey (n=7), PNP-AVSEU Interview, Medical Interview	Delayed or incomplete communication, lack of radios, inconsistent information sharing.
Limited Training and Exercises	ARFF Survey (n=19), ARFF Interview, PNP-AVSEU Interview, CSIS Interview, Medical Interview	Need for more ICS training, tabletop exercises, and full-scale aircraft accident drills.
Resource and Equipment Limitations	ARFF Survey (n=25), ARFF Interview, Medical Interview, PNP-AVSEU Interview	Need for additional rescue equipment, ambulances, medical resources, and specialized equipment.
Organizational and ICS Implementation Issues	ARFF Survey (n=4), CSIS Interview, Medical Interview, Document Analysis	Command confusion, role clarification, inconsistent application of ICS, overlap of ICS and EOC roles.
Environmental Management Limitations	ARFF Interview, Medical Interview, Document Analysis	Lack of explicit environmental management procedures, limited HAZMAT capability and environmental training.

Another problem mentioned repeatedly by the respondents was communication. ARFF personnel reported concerns regarding communication with external agencies during emergency response, while the PNP-AVSEU Head emphasized that communication failures could delay response operations. The Medical Team also explained that incomplete incident information and the absence of dedicated radio equipment may reduce response effectiveness. These findings indicated that although communication mechanisms currently function during routine operations, improvements in communication systems and information sharing would strengthen interagency coordination during large-scale on-airport commercial aircraft crash response.

Although respondents generally expressed confidence in current preparedness, nearly all interviewees recommended increasing the frequency of ICS training and emergency exercises. Suggestions included conducting more tabletop exercises, refresher courses, joint simulations, and full-scale aircraft

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accident drills involving all airport stakeholders. The CSIS Head also recommended including Job Order personnel in preparedness activities to ensure that all airport personnel understand their emergency roles. These findings indicate that continuous training remains essential for sustaining operational readiness and improving ICS implementation.

The respondents identified several resource gaps that could affect emergency response during commercial aircraft accidents. ARFF personnel emphasized the need for additional manpower, rescue equipment, disabled aircraft removal capability, and ambulances. The Medical Team highlighted limitations in medical equipment and specialized emergency resources, while the PNP-AVSEU Head recommended additional communication equipment, transportation resources, and funding to support emergency preparedness activities. Addressing these resource limitations would strengthen the airport's operational capability during major emergencies.

Several respondents identified organizational concerns affecting the implementation of ICS. Some ARFF personnel noted possible command structure confusion during emergency response, while the CSIS and Medical Team acknowledged that ICS principles are not yet consistently applied within their units. These findings support the document analysis conducted under Objective 1, which identified overlap between the Incident Command System and Emergency Operations Center organizational structures. Together, these observations indicate that clearer role definition, improved organizational guidance, and strengthened implementation of ICS principles are needed to achieve a more unified emergency response structure.

Environmental management was identified as an area requiring further development. The document analysis revealed that the Aerodrome Emergency Plan contains no explicit environmental management provisions, while the ARFF Unit Head reported limited HAZMAT capability and the need for specialized environmental response training. Although the Medical Team has established procedures for infectious waste management, environmental considerations are not yet fully integrated across all responding units. Strengthening environmental preparedness would improve the airport's ability to manage secondary hazards associated with on-airport commercial aircraft crashes.

Proposed Enhanced ICS Framework

The Proposed Enhanced Incident Command System (ICS) Framework for Commercial Aircraft Accident Management at Bicol Airport was developed based on the combined findings of the document analysis, ARFF personnel survey, and key informant interviews. As shown in Figure 2, the framework starts with the airport's existing emergency management arrangements, including the Aerodrome Emergency Plan (AEP), existing response units, and applicable disaster risk reduction and management (DRRM) arrangements and supporting policies. The study then identifies six major challenges within these existing arrangements: limited manpower, communication limitations, limited training and exercises, resource and equipment limitations, organizational and ICS implementation issues, and environmental management limitations. These challenges serve as the basis for the proposed enhancements to the ICS framework. The proposed framework aims to address the identified gaps by improving the organizational structure, personnel preparedness, resource management, communication, interagency coordination, and environmental management. It is intended to strengthen the airport's existing emergency management arrangements rather than replace them.

The proposed Enhanced ICS Framework has two separate but coordinated structures: the Incident Management Team (IMT) and the Emergency Operations Center (EOC). The IMT is responsible for managing the incident and directing the response at the scene, while the EOC provides coordination and support at the organizational level. In the proposed minimum IMT structure, the roles of the Incident Commander and Operations Section Chief are separated to avoid assigning overall command and direct supervision of operations to the same person. Under the Operations Section, four functional areas are identified: Fire and Rescue, Medical, Security, and Staging.

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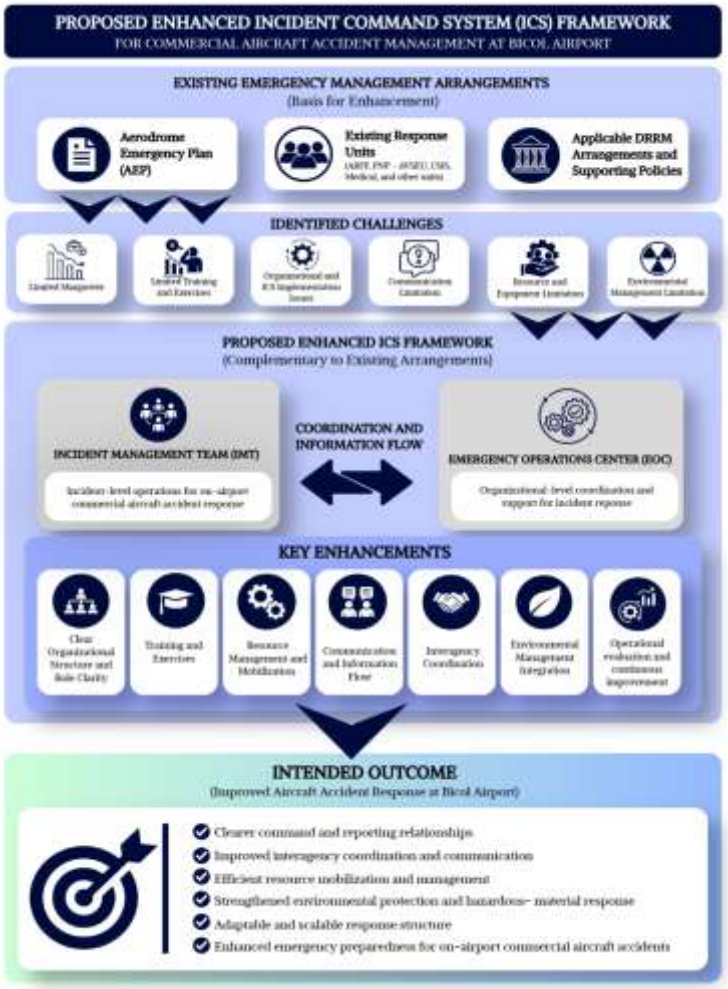

Figure 2. *Proposed Enhanced Incident Command System (ICS) Framework*

The EOC, on the other hand, provides support in areas such as information management, resource coordination, interagency liaison, planning, logistics, and administrative functions. Although the IMT and EOC have different responsibilities, they need to maintain communication and coordinate their activities throughout the response. Their organizational arrangements may also be adjusted depending on the seriousness of the incident, the personnel available, and the needs of the operation.

Aside from the proposed organizational structure, the framework includes seven areas that need to be strengthened: organizational structure and role clarity, training and exercises, resource management and mobilization, communication and information flow, interagency coordination, environmental management integration, and operational evaluation and continuous improvement. These areas address the challenges identified in the study. The proposed improvements include clarifying the duties of responding personnel, providing appropriate ICS training and emergency exercises, identifying additional resource requirements, and improving the way information is shared among responding units. The framework also emphasizes the importance of coordination with external agencies, especially when airport resources are not enough to manage an emergency. Environmental management is also included, particularly for incidents involving fuel spills and other environmental hazards. When necessary, a Pollution Control Officer or other qualified

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environmental personnel may be called upon to provide technical assistance and coordinate with appropriate external responders. Regular exercises, after-action reviews, and corrective actions are also proposed to help identify weaknesses and improve existing emergency procedures.

Table 9. *Proposed Enhancement of ICS on Commercial Aircraft Accident Management at Bicol Airport*

EXISTING CONDITION	CHALLENGES	PROPOSED ACTION/S
The Incident Commander (IC) is also designated as the Operations Section Chief.	Organizational and ICS Implementation Issues: Combining overall incident command and operational management may result in excessive workload and reduced span of control.	Separate the roles of Incident Commander and Operations Section Chief to distinguish overall incident command from operational management.
Multiple functions may directly report to the Incident Commander.	Organizational and ICS Implementation Issues: Multiple direct reporting relationships may increase communication demands and limit the IC's ability to focus on overall incident management.	Place operational functions under the Operations Section Chief to establish a more organized reporting structure.
ICS roles are identified, but organizational relationships are not clearly illustrated.	Organizational and ICS Implementation Issues: Unclear organizational relationships may create confusion regarding the chain of command and reporting responsibilities.	Provide proposed Incident Management Team (IMT) and Emergency Operations Center (EOC) organizational charts.
Operational functions are not sufficiently differentiated.	Organizational and ICS Implementation Issues: Unclear functional assignments may result in overlapping responsibilities and coordination difficulties during emergency response.	Establish Fire and Rescue, Medical, Security, and Staging functions under the Operations Section Chief.
Staging is not explicitly identified in the existing organizational arrangement.	Resource and Equipment Limitations: The absence of a clearly designated Staging function may affect responder accountability, resource organization, and deployment.	Establish Staging as an operational function under the Operations Section.
Personnel availability may limit the activation of a complete ICS organizational structure.	Limited Manpower: Limited personnel availability may affect the feasibility of activating all organizational positions during an emergency.	Establish minimum and scalable ICS organizational structures based on incident complexity, personnel availability, and operational requirements.
EOC functions require clearer organizational relationships.	Organizational and ICS Implementation Issues: Unclear EOC organizational arrangements may affect organizational-level coordination, resource support, and communication with the IMT.	Establish a proposed minimum EOC structure with clearly defined coordination and support responsibilities, separate from the IMT.
Environmental management is not explicitly addressed in the AEP reviewed.	Environmental Management Limitations: The absence of specific environmental management provisions may limit the identification of environmental	Provide for the conditional activation of a Pollution Control Officer (PCO) or qualified environmental technical personnel

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EXISTING CONDITION	CHALLENGES	PROPOSED ACTION/S
	hazards, technical support requirements, and coordination with external environmental responders.	and coordination with external environmental responders.
Training opportunities and participation in emergency preparedness activities are limited, particularly for Job Order (JO) personnel who may be assigned supporting functions during emergency operations.	Limited Training and Exercises: Insufficient training opportunities for JO personnel may affect their familiarity with emergency procedures, assigned responsibilities, and coordination requirements during airport emergencies.	Include JO personnel in appropriate ICS orientation, emergency preparedness training, and drills based on their designated functions and responsibilities.
Emergency response equipment and resources are available for initial response; however, these may be insufficient to support the operational demands of a major commercial aircraft crash.	Resource and Equipment Limitations: Limited availability of additional rescue equipment, specialized resources, and support capabilities may constrain sustained emergency operations during major aircraft accidents.	Strengthen resource allocation and mobilization arrangements through the identification of additional equipment requirements, provision of supplementary resources, and establishment of coordination mechanisms for obtaining external assistance.
Communication among responding units may be affected by limited communication equipment, delayed information sharing, or the absence of clearly established communication arrangements during joint emergency operations.	Communication Limitations: Communication constraints may delay the exchange of critical information and affect coordination among responding units during aircraft accident response.	Establish clear communication and information-sharing procedures within the proposed ICS structure, including defined reporting lines, communication responsibilities, and coordination arrangements between the IMT and EOC.

Table 9 presents the proposed improvements to the existing Incident Command System (ICS) arrangements for commercial aircraft accident management at Bicol Airport. These recommendations were based on the findings from the document analysis, survey, and key informant interviews. They aim to address the gaps identified in the study and improve how airport personnel and responding units organize, coordinate, and carry out their responsibilities during an emergency.

DISCUSSION

The findings also supported the theoretical foundations of the study, particularly Systems Theory and Contingency Theory. In relation to Systems Theory, the results demonstrate the importance of having connected and coordinated functions among the different units and agencies involved in emergency response. The AEP's provisions on communication, resource arrangements, operational procedures, and interagency coordination reflect the need for these components to work together toward a common emergency response objective. However, the gaps identified in the organizational structure and environmental management show that weaknesses in one area may affect the coordination of the overall system. Thus, the findings supportede Systems Theory by emphasizing the importance of clear relationships and coordination among the different components of airport emergency management.

The findings likewise supported Contingency Theory, which recognizes that organizational arrangements should be appropriate to the situation and the demands of the task. The need to clarify command responsibilities and distinguish the functions of the IMT and EOC shows that an established organizational structure must also be suitable for the type and complexity of an emergency. In the case of a major commercial aircraft crash, the response may require clearly assigned command functions, coordinated operational activities, and appropriate technical support. Therefore, the findings support the

application of Contingency Theory by highlighting the need for an ICS structure that can respond to the specific operational requirements of an airport emergency.

Overall, the document analysis showed that the AEP already establishes important arrangements for emergency management at Bicol Airport. However, the identified gaps indicate that these arrangements still need to be improved, particularly in terms of organizational clarity and environmental management. These findings provide the documentary basis for developing the proposed enhanced ICS framework.

The results have practical implications for improving ARFF operations at Bicol Airport. Existing training activities should be continued, with more frequent ICS refresher sessions and practical exercises to reinforce personnel knowledge and skills. Joint exercises involving the different airport response units should also be conducted so that responders can practice their respective functions and assess how well they coordinate under a common command structure. In addition, the airport should review its resource requirements, particularly in terms of manpower, rescue equipment, ambulances, and other specialized support needed during major aircraft crashes. Addressing these areas would help ensure that ARFF personnel are not only familiar with their duties but also have the training, experience, and resources needed to perform them effectively.

The findings are generally consistent with the study's theoretical foundations, particularly Systems Theory and Contingency Theory. In relation to Systems Theory, the results highlight the importance of having different personnel, units, and resources work together toward a common emergency response objective. The high level of awareness among ARFF personnel regarding their roles and the chain of command reflects the value of clearly defined responsibilities within an organization. However, the absence of joint aircraft crash exercises shows that coordination among the different airport response units still needs to be practiced and assessed. This supports the view that preparedness is not limited to the readiness of individual personnel but also depends on how well the different parts of the emergency response system work together.

The findings also supported Contingency Theory, which recognizes that organizational arrangements and available resources should be suited to the demands of a particular situation. While ARFF personnel reported high levels of awareness and confidence, a major commercial aircraft crash may require more personnel, specialized equipment, and a greater level of coordination than routine operations or unit-level exercises. The reported insufficiency of resources and the need for joint exercises show that response capabilities must be strengthened in consideration of the complexity and operational requirements of an incident. Thus, the findings are consistent with Contingency Theory because they show that individual preparedness must be matched with appropriate resources, training, and response arrangements.

Overall, the findings indicated that ARFF personnel have a strong foundation in terms of their knowledge of the ICS structure, understanding of assigned duties, and confidence in performing their responsibilities. However, preparing for a major commercial aircraft crash requires more than individual knowledge and confidence. It also calls for continuing training, coordinated exercises with other airport response units, sufficient manpower, and adequate emergency response resources. Strengthening these areas would help improve not only the preparedness of ARFF personnel but also their ability to function effectively as part of the airport's overall emergency response system.

These results pointed to several improvements that may be considered in strengthening aviation security at Bicol Airport. The responsibilities of CSIS and PNP-AVSEU should be clearly reflected in the airport's ICS arrangements, particularly their functions in access control, crowd management, ground security, and support to emergency operations. Personnel, including Job Order employees, should also receive ICS orientation appropriate to their assigned functions. Regular tabletop exercises, communication exercises, and joint simulations involving other airport response units would give security personnel an opportunity to practice their roles and become more familiar with the airport's command and coordination arrangements. The airport should also review communication requirements and funding needs to identify areas that require additional support. Through these improvements, security personnel can become better

prepared not only to carry out their own duties but also to coordinate with other responders during a major aircraft crash.

The results are generally consistent with Systems Theory, which emphasizes that different parts of an organization must work together to achieve a common objective. Both key informants (2 out of 2) described established responsibilities and communication arrangements within their respective units. These responsibilities are complementary because maintaining airport security during an emergency requires the participation of different personnel and units. Their emphasis on communication, coordination, and joint exercises also reflects the importance of cooperation within the airport emergency response system. However, the absence of a joint aircraft crash exercise involving full ICS implementation means that coordination among these units and other responders has not yet been demonstrated under such conditions. The findings therefore support Systems Theory, while also showing that the airport needs to strengthen the working relationships among its emergency response units.

The results also supported Contingency Theory, which recognizes that organizational arrangements and available resources must be suited to the situation being addressed. The confidence expressed by both key informants is based mainly on their units' routine security responsibilities, existing training, and available resources. However, responding to a major commercial aircraft crash may involve demands that go beyond normal airport security operations. Additional coordination, personnel, communication support, and resources may be needed depending on the scale and complexity of the incident. The concerns raised by the PNP-AVSEU Head regarding funding and communication, together with the recommendations for more frequent exercises, show why existing arrangements must be reviewed and strengthened to meet the demands of more complex emergencies. In this regard, the findings are consistent with Contingency Theory because they highlight the need to match preparedness arrangements with the requirements of a particular emergency.

In summary, CSIS and PNP-AVSEU have established responsibilities, relevant training, and communication arrangements that support aviation security preparedness at Bicol Airport. However, being familiar with their individual duties does not automatically mean that personnel are already prepared to coordinate with all other responding units during a major aircraft crash. Regular joint exercises, continuing ICS training, reliable communication systems, and adequate funding remain important areas for improvement. These concerns should be considered in developing the proposed Enhanced Incident Command System Framework, particularly in clarifying the functions of aviation security units and strengthening their coordination with the rest of the airport emergency response organization.

The findings have practical implications for improving the enforcement of safety and emergency protocols at Bicol Airport. The roles and responsibilities of each responding unit should be clearly defined within the airport's ICS arrangements, particularly for functions that require coordination with other units. The Medical Team's ICS responsibilities and aircraft crash response procedures should receive particular attention so that its personnel understand their reporting relationships and operational functions during an emergency. CSIS personnel, including Job Order employees with assigned emergency duties, should also receive appropriate ICS orientation. For ARFF and PNP-AVSEU, existing training and operational preparedness activities should be sustained and further strengthened. In addition, regular multi-agency tabletop exercises and full-scale exercises should be conducted to allow all responding units to practice their assigned functions and coordination under a common command structure. These measures would help address differences in ICS familiarity and promote more consistent implementation of emergency protocols throughout the airport.

The findings are generally consistent with Systems Theory, which emphasizes the importance of coordination among the different components of an organization. All four key informants (4 out of 4) described established procedures and responsibilities within their respective units. However, the differences in their reported application of ICS show that the existence of individual unit procedures is not enough to ensure that the entire emergency response organization functions as one coordinated system. The concerns

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raised by CSIS and the Medical Team regarding ICS implementation further highlight the need to establish clear relationships among the different responding units. Thus, the findings support Systems Theory by showing that effective emergency response depends not only on the performance of individual units but also on how well their functions are connected and coordinated.

The findings also supported Contingency Theory, which recognizes that organizational arrangements and response procedures must be appropriate to the requirements of a particular situation. Each airport response unit has different responsibilities and operational needs. For example, ARFF focuses on rescue and firefighting, aviation security units maintain security and control access, while the Medical Team provides emergency medical care. These differences require specific procedures and clearly assigned ICS functions suited to each unit. The reported limitations in medical response procedures and ICS implementation within CSIS and the Medical Team show that existing arrangements may need to be further developed to address the demands of a major commercial aircraft crash. The findings are therefore consistent with Contingency Theory because they highlighted the need to adapt training, responsibilities, and response arrangements to the functions of each unit and the complexity of the emergency.

Overall, the interviews showed that Bicol Airport's responding units have established safety and emergency procedures, but the application of ICS is not yet consistent across all four units. While ARFF and PNP-AVSEU reported greater familiarity with ICS implementation, CSIS and the Medical Team identified areas requiring further clarification and improvement. Strengthening unit-specific ICS guidance, conducting regular multi-agency exercises, and clarifying command and reporting relationships would help bring the different units under a more consistent emergency response arrangement. These improvements should be considered in the proposed Enhanced Incident Command System Framework to strengthen the enforcement of safety and emergency protocols during on-airport commercial aircraft crashes.

These findings pointed to several improvements that may be considered for the Medical Team. The airport should review the unit's staffing requirements, particularly the availability of medical personnel during incidents involving several casualties. Additional medical equipment and specialized resources should also be identified based on the possible demands of a major aircraft crash. All medical personnel should be given appropriate ICS and EOC training so that they understand their assigned functions and reporting relationships during emergency operations. Clearer procedures should also be established for medical response during aircraft crash, including patient assessment, triage, stabilization, and coordination with receiving medical facilities and external support organizations. Providing dedicated communication equipment and including the Medical Team in joint emergency exercises would further help personnel prepare for actual response conditions.

The findings are consistent with Systems Theory, which emphasizes that the different parts of an organization must work together to achieve a common goal. During an aircraft crash, the Medical Team cannot perform its responsibilities independently. It needs to coordinate with ARFF during rescue operations, security personnel for access and movement within the incident area, and other agencies for patient transport and additional medical support. The communication difficulties and unclear ICS assignments identified during the interview show how limitations within one unit may affect the work of the entire emergency response organization. In this regard, the findings support Systems Theory by showing that effective medical response depends not only on the capabilities of the Medical Team but also on how well it coordinates with the other responding units.

The findings also supported Contingency Theory, which recognizes that the resources and arrangements of an organization should match the demands of the situation. According to the Medical Unit Head, the current staffing and equipment are generally adequate for routine passenger medical incidents and initial emergency care. However, a major commercial aircraft crash involving several casualties would require more medical personnel, specialized equipment, and additional support. The difference between what the team can currently handle during routine incidents and what may be required during a mass casualty event shows the need to strengthen its capabilities according to the scale of the emergency. Thus,

the findings are consistent with Contingency Theory because they highlighted the importance of having response arrangements that are appropriate to the demands of a particular incident.

In summary, the Medical Team has the basic qualifications and resources to provide initial medical assistance during airport emergencies. However, responding to a major commercial aircraft crash would present demands that may exceed its current capacity. The limited number of personnel, need for additional medical resources, lack of specialized training, communication difficulties, and incomplete ICS arrangements all require attention. Addressing these concerns through additional training, clearer procedures, improved communication, adequate resources, and regular joint exercises would help the Medical Team perform its responsibilities more effectively as part of the airport's emergency response system. These areas should be considered in the proposed Enhanced Incident Command System Framework, particularly in defining medical response functions and strengthening coordination with other responding units.

One area that deserves attention is the way incident information is shared among responding units. Having radios and mobile phones is useful, but personnel must also receive accurate and sufficient information to prepare for their assigned tasks. For example, the Medical Team needs to know the nature of the emergency and the possible medical requirements before responding. Similarly, other units need timely information to determine the appropriate actions within their respective functions. The airport should therefore strengthen its communication procedures, provide suitable communication equipment to units that need it, and ensure that important incident information is properly relayed to the concerned responders.

Regular joint preparedness activities should also be continued and expanded. Tabletop exercises and communication drills can help units identify possible problems in their coordination arrangements before these are tested during an actual emergency. The participation of JO personnel with assigned emergency functions should also be considered in appropriate ICS orientations and exercises. In this way, preparedness activities can help ensure that everyone involved understands their responsibilities and knows how to coordinate with the other responding units.

These findings are consistent with Systems Theory, which emphasizes that the different parts of an organization depend on one another to achieve a common goal. At Bicol Airport, each responding unit has its own responsibilities, but no unit can manage a major aircraft crash entirely on its own. The concerns raised by the PNP-AVSEU and Medical Team Heads show how communication difficulties in one unit may affect the work of other responders. This highlights the need for clear communication and coordination arrangements across the airport's emergency response system.

The findings are also consistent with Contingency Theory because the communication arrangements needed for an emergency may differ depending on its nature and severity. The methods currently used may be sufficient for routine operations and scheduled drills. However, a major commercial aircraft crash would require several units to exchange information and coordinate their actions within a limited period. Under these conditions, delays, incomplete information, or inadequate communication equipment could affect the overall response. The airport must therefore ensure that its communication arrangements are suitable not only for routine situations but also for emergencies involving more complex response requirements.

Overall, the interviews show that Bicol Airport already has working coordination practices and communication channels among its responding units. However, the findings also showed that these arrangements still have limitations, particularly in the timely sharing of information, availability of communication equipment, and participation of all personnel in preparedness activities. Since coordination during an actual commercial aircraft crash has not yet been tested, these areas should be addressed as part of the proposed Enhanced Incident Command System Framework. Strengthening them would help the responding units work together more effectively when faced with a major airport emergency.

Overall, the findings showed that Bicol Airport has an existing foundation for emergency preparedness, with responding units having established responsibilities, basic emergency procedures,

trained personnel, and resources to carry out their respective functions. ARFF personnel reported a high level of perceived preparedness, while the interviews revealed that CSIS, PNP-AVSEU, and the Medical Team also have existing capabilities to perform their assigned duties. However, gaps remain in resource sufficiency, manpower, specialized training, communication, and the consistent application of ICS across the responding units. Although the units have experience coordinating during other airport emergency drills, their ability to work together under a common command structure during a commercial aircraft crash has not yet been fully tested through a joint exercise. These findings highlight the need to strengthen training, resource mobilization, communication, and interagency coordination, which will serve as the basis for the proposed Enhanced Incident Command System Framework.

The possible effects of these challenges can be further understood through a hypothetical commercial aircraft crash at Bicol Airport involving an aircraft fire, multiple casualties, and an aviation fuel spill. Such an incident would require ARFF, medical responders, aviation security, and other concerned agencies to perform their respective functions while coordinating under a common command structure. Limitations in manpower, equipment, and communication could affect the timely delivery of response services, while unclear command relationships could make coordination more difficult. The fuel spill would also require appropriate environmental assessment and coordination with qualified personnel and external responders. Although these difficulties cannot be assumed to occur in an actual incident, the scenario illustrates why the challenges identified in the study need to be addressed before such an emergency takes place.

Overall, the findings indicated that the implementation of the Incident Command System at Bicol Airport is supported by committed response organizations and established emergency procedures. However, several operational challenges remain, including manpower limitations, communication issues, limited training opportunities, resource constraints, organizational inconsistencies, and insufficient integration of environmental management. The findings also identified the need for additional funding support for emergency preparedness activities and the availability of necessary emergency resources. Addressing these challenges and operational needs would strengthen the effectiveness of ICS implementation and provide the basis for the proposed Enhanced Incident Command System Framework for on-airport commercial aircraft crash response.

The proposed framework also draws on Systems Theory and Contingency Theory. Systems Theory supports the need for the IMT, EOC, airport response units, and external agencies to work together, since the actions of one group can affect the overall emergency response. Contingency Theory is reflected in the use of minimum and scalable organizational structures. This means that the airport does not have to activate every position for every incident. Instead, the structure may be adjusted depending on the nature and complexity of the emergency and the personnel and resources available.

Overall, the proposed Enhanced ICS Framework is the main output of this study. It builds on the airport's existing emergency management arrangements and addresses the gaps identified through the document analysis, survey, and interviews. The proposed improvements are intended to provide clearer command relationships, better coordination among responding units, more organized resource management, and greater attention to environmental concerns during commercial aircraft accident response. However, since the framework has not yet been implemented and tested, its actual effectiveness cannot yet be established. It will need to undergo further review and be assessed through appropriate emergency exercises and subsequent improvements. The complete framework, including the detailed IMT and EOC organizational structures, proposed enhancement measures, implementation priorities, and illustrative application, is presented in Appendix J.

One of the main improvements concerns the organizational structure and the assignment of responsibilities. The proposed framework separates the roles of the Incident Commander (IC) and the Operations Section Chief so that the IC can focus on overall incident management while the Operations Section Chief supervises the actual response activities. It also places Fire and Rescue, Medical, Security,

and Staging under the Operations Section to provide clearer responsibilities and reporting relationships. The proposed IMT and EOC organizational charts are intended to make the functions of these two structures easier to understand. The IMT handles incident command and operational response, while the EOC provides coordination and support. Considering the limited availability of personnel, the framework also allows for minimum and scalable organizational structures that can be adjusted depending on the size and complexity of the incident and the personnel available.

The proposed actions also address the concerns raised about training, resources, and communication. Including JO personnel in appropriate ICS orientations, emergency preparedness training, and drills can help them understand the procedures and supporting functions assigned to them during an emergency. For resource management, the recommendations include identifying additional equipment needs, providing supplementary resources, and establishing arrangements for requesting assistance from external agencies when airport resources are not enough. Clearer communication and information-sharing procedures are also needed to help ensure that important incident information reaches the concerned units on time and that coordination between the IMT and EOC is maintained.

Environmental management is another area that needs attention. The AEP reviewed in this study does not contain specific provisions for environmental management during an aircraft accident. To address this gap, the proposed framework includes the conditional activation of a Pollution Control Officer (PCO) or other qualified environmental personnel when their assistance is needed. Coordination with external environmental responders may also be necessary, particularly in incidents involving aviation fuel spills or other hazardous materials. This would help ensure that environmental concerns are considered along with rescue, firefighting, medical, and security operations.

Taken together, the proposed actions respond to the six major challenges identified in the study: limited manpower, communication limitations, limited training and exercises, resource and equipment limitations, organizational and ICS implementation issues, and environmental management limitations. These improvements are intended to strengthen the airport's existing emergency management arrangements rather than replace them. Their implementation will require the involvement of airport management, concerned response units, and relevant external agencies. The proposed framework should also be tested and reviewed through appropriate emergency exercises, followed by after-action reviews and corrective measures. Since it has not yet undergone operational validation, its actual effectiveness will still need to be determined through future implementation and evaluation.

Limitations

This study focused on the enhancement of the Incident Command System (ICS) for commercial aircraft accident management at Bicol Airport, with the study specifically delimited to the management of on-airport commercial aircraft crashes. It examined the existing emergency management arrangements and ICS implementation at Bicol Airport in terms of skills training, resource allocation and mobilization, interagency coordination and collaboration, integration of environmental management, ICS organizational structure, communication procedures, and operational response procedures.

The study covered the preparedness and operational arrangements of the major airport response units involved in aircraft crash management, particularly the Aerodrome Rescue and Firefighting (ARFF) Unit, Philippine National Police–Aviation Security Unit (PNP-AVSEU), Civil Security and Intelligence Service (CSIS), and Medical Unit. The quantitative assessment of perceived preparedness is limited to twenty-seven (27) operational ARFF personnel, whose frontline responsibilities and participation in relevant emergency preparedness activities provide a basis for assessing their perceived preparedness. The perspectives of the ARFF, CSIS, Medical Unit, and PNP-AVSEU are further examined through key informant interviews with their respective unit heads. The study also examines the Bicol Airport Aerodrome Emergency Plan (AEP) as the primary document for assessing existing policies, procedures, organizational arrangements, and emergency response provisions.

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The study recognized the Aerodrome Emergency Plan (AEP) as the primary documented basis for emergency preparedness and response at Bicol Airport. Its provisions are examined in relation to the essential components of the Incident Command System (ICS) during on-airport commercial aircraft crashes. Although the AEP establishes various emergency management arrangements, this study does not independently assess the completeness of the airport's overall disaster risk reduction and management arrangements or all programs and activities that may fall under disaster prevention, mitigation, preparedness, response, and recovery. Instead, the assessment is limited to the provisions of the AEP and the relevant organizational, operational, and preparedness arrangements covered by the research objectives.

The study is delimited to on-airport commercial aircraft crashes and does not cover general aviation, private aviation, military aircraft incidents, or off-airport aircraft accidents. It does not seek to develop a framework applicable to all types of aviation emergencies or to other airports. The proposed Enhanced ICS Framework is therefore developed specifically in consideration of the operational context, existing arrangements, identified gaps, and response requirements of Bicol Airport for on-airport commercial aircraft crash management.

The study further focused on the organizational and operational aspects of ICS and does not evaluate the technical airworthiness of aircraft, aircraft maintenance, accident causation, or the investigation of aircraft accidents. The proposed framework is intended as an enhancement of the existing ICS arrangements and is based on the findings from the document analysis, ARFF personnel assessment, and key informant interviews conducted within the scope of the study.

The study also presented a hypothetical on-airport commercial aircraft crash scenario involving aircraft fire, injuries among passengers and crew members, aviation fuel leakage, and localized soil contamination. The scenario is intended to illustrate the possible emergency response requirements and application of the proposed Enhanced ICS Framework. Environmental management is considered in terms of incident command, technical support, coordination, and resource mobilization. Specialized environmental containment, cleanup, and soil remediation may be undertaken by qualified external responders when required. However, the operational capabilities, preparedness, and effectiveness of these external responders, as well as the technical methods of soil remediation, are outside the scope of this study. The hypothetical scenario does not constitute an actual emergency exercise, simulation, or formal evaluation of the proposed framework.

The study considered disaster risk reduction and management (DRRM) arrangements only insofar as they relate to the implementation of the Incident Command System during on-airport commercial aircraft crashes at Bicol Airport. It did not undertake a comprehensive assessment of the airport's overall DRRM system or the disaster preparedness and response arrangements of external government agencies. Although interagency coordination and communication are examined through the Aerodrome Emergency Plan, ARFF personnel survey, and key informant interviews, the study does not independently evaluate the actual effectiveness of communication systems and coordination procedures among all external responding agencies during a full-scale aircraft accident emergency. These aspects would require further assessment involving the concerned agencies and appropriate emergency exercises.

CONCLUSION

The Bicol Airport Aerodrome Emergency Plan (AEP) addresses most essential ICS components, including training, resource mobilization, communication, operational response, and interagency coordination. However, improvements are needed in clarifying the ICS and EOC structures, defining command responsibilities and reporting relationships, and integrating environmental management provisions.

The 27 operational ARFF personnel generally perceived themselves as prepared for their assigned emergency response duties. Interviews with the heads of ARFF, PNP-AVSEU, CSIS, and the Medical Unit further revealed established responsibilities and response practices, while identifying the need to strengthen

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role clarification, communication, training, and interagency integration. This survey findings reflect perceived rather than independently verified operational preparedness.

Six major challenges were identified: manpower, communication, training and exercises, resources and equipment, organizational and ICS implementation, and environmental management. These highlight the need for adequate personnel and resources, more frequent joint exercises, clearer command relationships, improved communication, and stronger environmental and hazardous-material response arrangements.

The study proposed an Enhanced Incident Command System Framework for Commercial Aircraft Accident Management at Bicol Airport. It addresses the identified gaps through clearer command and reporting relationships, distinct ICS and EOC structures, defined operational functions, and improvements in training, resource mobilization, communication, interagency coordination, environmental preparedness, and continuous evaluation. Its operational effectiveness remains subject to formal review, implementation, and evaluation through emergency exercises.

Recommendations

Review and enhancement of the Aerodrome Emergency Plan. Bicol Airport management, in coordination with the concerned response units and appropriate CAAP offices, should review the existing AEP to address the identified gaps in ICS organizational structure, chain of command, communication, and environmental management. The review should include a clear organizational diagram showing reporting relationships and the distinction between incident-level command and organizational-level coordination.

Clarification of ICS roles and responsibilities. The proposed Enhanced ICS Framework should be considered as a basis for clarifying the responsibilities of the Incident Commander, Operations Section Chief, and other designated ICS positions. The Incident Commander should retain overall incident command, while the Operations Section Chief should manage and coordinate field-level operational activities under the Incident Commander's direction. The ICS and EOC should be presented as distinct but coordinated structures, with the EOC supporting information management, resource coordination, and organizational-level support without duplicating field command responsibilities.

Bicol Airport management, in coordination with the concerned CAAP offices and airport response units, should consider formally designating personnel for the appropriate Incident Management Team functions based on their roles, qualifications, and relevant training. The designation should clarify responsibilities, reporting relationships, and coordination with the Incident Commander, Operations Section Chief, and Emergency Operations Center (EOC). The proposed arrangements should be incorporated into the Aerodrome Emergency Plan, as appropriate, and assessed through emergency exercises.

Strengthening of training and emergency exercises. Bicol Airport should establish or strengthen a continuing ICS training and exercise program for relevant airport personnel and responding agencies. Activities should include ICS orientation, role-specific training, tabletop exercises, functional exercises, and full-scale aircraft accident exercises when feasible. Job Order employees and other personnel who may have assigned emergency support functions should also receive appropriate orientation. Exercise results should be documented and used to identify corrective actions and further training needs. Future tabletop and functional exercises may also use the hypothetical on-airport commercial aircraft crash scenario presented in this study to assess incident command relationships, coordination among airport response units, environmental technical support, and procedures for requesting specialized external environmental assistance.

Improvement of communication and interagency coordination. The airport should review communication arrangements among ARFF, PNP-AVSEU, CSIS, the Medical Unit, airport management, and external support agencies. This review should consider the availability of compatible communication equipment, timely transmission of incident information, notification procedures, reporting channels, and

coordination arrangements. Joint exercises should be used to assess whether the established communication procedures and reporting relationships function as intended.

Assessment of manpower, equipment, and medical resources. Bicol Airport should periodically assess personnel requirements and the availability and sufficiency of rescue equipment, ambulances, medical supplies, communication equipment, and other resources needed for large-scale commercial aircraft crash response. The assessment should identify resource gaps, priority requirements, possible augmentation arrangements, and appropriate mutual-aid support. Necessary budgetary and funding support should be identified in accordance with applicable government budgeting, procurement, accounting, and auditing requirements.

Integration of environmental management into emergency response. Bicol Airport should incorporate clearer environmental management provisions into the Aerodrome Emergency Plan and related emergency arrangements. These provisions should address environmental hazards associated with aircraft crashes, including aviation fuel spills and possible soil contamination. The airport should establish procedures for activating its designated Pollution Control Officer (PCO) or other appropriately qualified environmental personnel to provide technical assistance to the Incident Commander and Safety Officer. The procedures should also clarify environmental assessment, initial protective measures, incident documentation, coordination with appropriate environmental authorities, and applicable regulatory notification and reporting requirements. Specialized environmental containment, cleanup, and remediation activities may be coordinated with qualified external responders when necessary and when incident conditions permit. Environmental technical support and external assistance arrangements should be included in future emergency planning and exercises. The operational capabilities and preparedness of external environmental responders would require separate assessment beyond the scope of this study.

Implementation and periodic review of the proposed framework. The proposed Enhanced ICS Framework should undergo review by appropriate airport management, emergency response representatives, and other relevant technical personnel before adoption. If approved, the framework should be incorporated into applicable airport emergency planning documents and supporting procedures. Its implementation should be monitored through exercises, post-exercise evaluations, incident reviews where applicable, and documented corrective actions. The framework should be revised when findings, operational changes, or updated requirements indicate a need for improvement.

Further evaluation by future researchers. Future researchers may assess the applicability of the proposed framework through expert review, pilot implementation, or full-scale emergency exercises. Further studies may also examine the preparedness of other response units using suitable assessment methods after those units have participated in relevant aircraft accident exercises. Such studies may provide additional evidence on the framework's practical applicability and identify further opportunities for improvement in airport emergency management.

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