Evaluation of the Effectiveness of Communication and IT Infrastructure Recovery Post-Disaster Based on COBIT 2019 with a Mixed Method Approach (Case Study of the 2025 Sumatra Flood/Landslide)

Muhammad Hasanuddin, Muhammad Amin

Natural disasters such as floods and landslides significantly impact the continuity of information technology services, particularly in disaster-prone areas such as Sumatra. This study aims to evaluate the effectiveness of information technology, communication, and infrastructure recovery following the 2025 flood and landslide disaster in Sumatra. A mixedmethods approach was used, integrating quantitative and qualitative techniques, with the COBIT 2019 framework as the primary evaluation tool to assess the governance and management processes associated with post-disaster information technology operations. Quantitative data were collected through a capability-based questionnaire to measure the maturity level of selected COBIT 2019 processes, while qualitative data were obtained through interviews and document analysis to capture contextual conditions and implementation challenges. The results indicate that most information technology processes are at the defined to managed capability level, reflecting the existence of basic policies and procedures but limited effectiveness during crisis situations. Key challenges were identified in emergency communication mechanisms, incident handling, and service continuity, which contributed to delays in infrastructure recovery. This study demonstrates that integrating COBIT 2019 with a mixed-methods approach provides a comprehensive evaluation of postdisaster information technology governance. These findings offer practical insights for improving communication effectiveness and strengthening information technology resilience, while contributing to the growing body of knowledge on information technology governance in the context of disaster management.

Keywords: *Information Technology Governance; COBIT 2019; Post-Disaster Information Technology; Mixed Methods; Infrastructure Recovery; Emergency Communications*

Muhammad Hasanuddin[1]
[1]Information Technology, Universitas Pembangunan Panca Budi, Indonesia
e-mail: muhammadhasan20fen@gmail.com[1]

Mmuhammad Amin[2]
[2]Information Technology, Universitas Pembangunan Panca Budi, Indonesia
e-mail: mhdamin@dosen.pancabudi.ac.id[2]
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Introduction

Natural disasters are one of the biggest challenges for the continuity of public services and organizational operations, especially in regions with high vulnerability levels like Indonesia[1]. Throughout the year 2025, several regions in Sumatra experienced floods and landslides with significant impacts on government activities, the economic sector, and social services[2]. In this context, Information Technology (IT) plays a crucial role as the backbone of communication, coordination, and the provision of digital services[3]. The increasing dependence on information systems makes disruptions to IT infrastructure a factor that can slow down emergency response and post-disaster recovery[4]. Therefore, the effectiveness of ITbased communication and the organization's ability to restore IT infrastructure have become strategic issues that require serious attention from the perspective of IT governance and management. Several recent studies emphasize that communication failures and the weak readiness of IT infrastructure post-disaster are often caused by a lack of planning[5], inter-unit coordination, and the absence of a standardized IT governance framework. Studies in the past five years have shown that organizations with mature IT governance tend to recover more quickly and are able to maintain service continuity even in crisis conditions[6]. Frameworks such as ITIL, ISO/IEC 27001, and COBIT have been widely used to evaluate and improve IT management, including in the context of risk management and service continuity. However, the literature also indicates that the application of these frameworks in post-disaster situations, particularly in the regional public sector and disaster-prone areas, is still relatively limited and not yet systematically integrated[7].

The main issues that emerged in the context of the flood and landslide disaster in Sumatra in 2025 were the low effectiveness of IT communication among stakeholders and the slow recovery process of IT infrastructure. Network disruptions, data center damage, limited IT human resources, and suboptimal emergency communication procedures caused delays in information distribution and decision-making[8]. This condition not only affects the internal organization but also the community that relies on government information services. Without a structured evaluation, the organization risks repeating the same weaknesses in the next disaster event.

In general, the solutions often proposed in various studies are strengthening IT risk management, developing a Disaster Recovery Plan (DRP), and improving coordination thru an integrated communication system[9]. Although these solutions sound normative, their implementation in the field often faces obstacles, especially in terms of measuring effectiveness and the maturity level of IT processes. Many organizations do not yet have evaluation tools capable of linking communication practices and IT infrastructure recovery with organizational goals comprehensively. As a result, the improvement efforts tend to be partial and unsustainable[10].

Scientific literature shows that the COBIT 2019 framework offers a comprehensive approach to evaluating IT governance and management thru the measurement of process capability levels. Several previous studies have utilized COBIT 2019 to assess IT readiness, risk management, and service continuity in the banking, education, and government sectors. The results of the research indicate that COBIT 2019 is capable of identifying gaps between actual conditions and expected conditions, while also providing improvement recommendations that align with organizational goals. In the context of disasters, domains such as Align, Plan, and Organize (APO) and Deliver, Service, and Support (DSS) are considered relevant for evaluating communication planning, incident handling, and IT service recovery. On the other hand, the methodological approach used in IT evaluation research is also an important factor. Previous research heavily relied on quantitative approaches based on questionnaires or document audits, which, although providing numerical insights, often failed to capture the complexity of post-disaster field conditions[11]. Some other studies use a qualitative approach thru in-depth interviews to understand the processes and constraints of IT implementation, but face limitations in terms of generalization and measuring the level of effectiveness. Therefore, the research

methodology literature recommends the use of a mixedmethod approach as a solution to combine the strengths of quantitative and qualitative data within a unified analytical framework. Various studies that combine the COBIT framework with a mixed-method approach show more comprehensive results compared to the use of a single method[12]. This approach allows researchers to not only measure the level of IT process capability quantitatively but also understand the contextual factors that influence IT performance thru qualitative data. Nevertheless, the literature review reveals that the application of the combination of COBIT 2019 and mixed methods in the context of evaluating communication and IT infrastructure recovery post-disaster is still very limited, particularly in case studies of natural disasters in Indonesia. Most research still focuses on technical or managerial aspects separately[13], without explicitly linking them to the crisis conditions caused by disasters.

The research gap indicates the need for studies that specifically evaluate the effectiveness of communication and IT infrastructure recovery post-disaster using standardized IT governance frameworks and comprehensive methodological approaches. Until now, there has been little research examining how the level of IT process capability based on COBIT 2019 relates to emergency communication practices and IT infrastructure recovery in disaster-prone areas. Moreover, the context of flood and landslide disasters in Sumatra in 2025 presents unique characteristics that have not been well-documented in the international literature, thus opening up significant opportunities for scientific contribution[14].

Based on the description, this research aims to evaluate the effectiveness of communication and IT infrastructure recovery post-flood and landslide disasters in Sumatra in 2025 using the COBIT 2019 framework and a mixed-method approach. The novelty of this research lies in the integration of COBIT 2019-based IT process capability evaluation with qualitative analysis of IT communication and recovery practices in post-disaster situations[15]. The scope of the research focuses on COBIT domains relevant to planning, risk management, incident handling, and IT service continuity. The research results are expected to contribute theoretically to the development of IT governance literature in the context of disasters, as well as provide practical contributions in the form of strategic recommendations to enhance organizational IT preparedness and resilience in disaster-prone areas.

Research Methodology

2.1 Research Design and Approach

This research employs a mixed-method approach, which is a combination of quantitative and qualitative methods, using the COBIT 2019 framework as the basis for evaluating the governance and management of Information Technology (IT) in the context of communication and recovery of IT infrastructure post-flood and landslide disasters in Sumatra in 2025. The mixed-method approach was chosen to obtain a comprehensive understanding thru structured measurement of IT process capability levels and in-depth exploration of the conditions and practices of IT recovery in the field. The mixed-method design used is the convergent parallel design, where the collection of quantitative and qualitative data is conducted in parallel during the same research period. Both types of data are analyzed separately, then integrated at the interpretation stage to strengthen the validity and reliability of the research findings.

2.2 COBIT 2019 Framework The COBIT 2019 framework is used as the main reference in developing variables, indicators, and research instruments. This research focuses the evaluation on the COBIT 2019 domains relevant to communication and recovery of IT infrastructure postdisaster, namely the Align, Plan, and Organize (APO) domain and the Deliver, Service, and Support (DSS) domain. The APO domain is used to evaluate aspects of planning, risk management, and IT communication management, while the DSS domain is used to assess IT service operations, incident handling, and the continuity and recovery of IT services postdisaster. The selection of these domains is based on their alignment with the research objectives and the characteristics of the issues being studied.

2.3 Techniques and Sources of Data Collection

Research data were collected thru two main approaches, namely quantitative and qualitative. Quantitative data were obtained thru the distribution of questionnaires to respondents directly involved in the management and operation of IT post-disaster, such as IT managers, technical staff for networks and information systems, and IT service support personnel. Qualitative data were collected thru in-depth interviews and documentation studies. Interviews were conducted semi-structured to explore information related to emergency communication flows, IT decisionmaking processes, and strategies and challenges in IT infrastructure recovery. Documentation studies included reviews of policies, standard operating procedures, incident reports, and IT disaster recovery planning documents.

2.4 Research Instrument

The quantitative research instrument in the form of a questionnaire was developed based on the Capability Level model of COBIT 2019, using a five-point Likert scale. Each statement in the questionnaire represents practices and activities in the APO and DSS domains that are evaluated in this study.

The qualitative instrument in the form of an interview guideline is designed to ensure the consistency of questions and alignment with the research focus. The interview guidelines are developed with reference to the COBIT 2019 processes and practices, so that the interview results can be systematically mapped into the evaluated domains and processes.

2.5 Quantitative Data Analysis Techniques

Quantitative data analysis is conducted by calculating the average score of respondents' answers on each indicator to determine the capability level of IT processes. The average scores are then mapped into the COBIT 2019 Capability Levels, ranging from level 0 (incomplete) to level 5 (optimizing).

Next, a gap analysis is conducted by comparing the actual capability level obtained from the measurement results with the expected capability level. The results of this analysis are used to identify priority areas that require improvement in enhancing the effectiveness of communication and post-disaster IT infrastructure recovery.

2.6 Qualitative Data Analysis Techniques

Qualitative data analysis is conducted using thematic analysis, which involves grouping interview and documentation data into themes aligned with the COBIT 2019 domains and processes. This analysis process includes stages of coding, categorization, and data interpretation to identify patterns, effective practices, and key issues in post-disaster communication and IT recovery.

The results of the qualitative analysis are used to provide context and in-depth explanations of the quantitative findings, as well as to uncover non-technical factors that influence the capability levels of IT processes.

2.7 Data Integration (Mixed Method)

The integration of quantitative and qualitative data is carried out at the stage of interpreting the research results. The measurement results of the IT process capability levels are compared with the qualitative findings to assess the consistency and alignment between numerical data and field conditions. The discrepancies found are further analyzed to identify the causes and their implications on the effectiveness of communication and the recovery of IT infrastructure post-disaster. This integrative approach allows researchers to produce more comprehensive conclusions and more contextual and applicable recommendations.

2.8 Research Outputs and Outcomes

The outputs of this research include mapping the capability levels of IT processes based on COBIT 2019, gap analysis between actual conditions and expected conditions, and strategic recommendations to improve the effectiveness of communication and IT infrastructure recovery post-disaster. The recommendations are formulated by referring to the principles and best practices of COBIT 2019 and are tailored to the characteristics of the organization and the conditions of the research area.

Results

3.1 Characteristics of Research Respondents

The quantitative research respondents consisted of personnel directly involved in the management and operation of Information Technology (IT) following the flood and landslide disaster in Sumatra in 2025. Respondents included IT managers, network and information systems technical staff, and IT service support officers with direct experience in emergency communications and IT infrastructure recovery. The composition of respondents represented strategic and operational functions, ensuring that the data obtained reflected the actual state of IT governance and management post-disaster.

On the qualitative side, the research informants consisted of IT management officials, emergency communications coordinators, and technical personnel involved in incident response and system recovery. Informants were selected based on their direct involvement in the decision-making process and implementation of IT infrastructure recovery, thus providing an in-depth overview of the practices, constraints, and dynamics that occurred during the postdisaster period..

3.2 COBIT 2019 Capability Level Measurement Results

IT process capability levels were measured based on the Align, Plan, and Organize (APO) and Deliver, Service, and Support (DSS) domains. The questionnaire data processing results indicated that the IT process capability levels generally ranged from defined to managed, with significant variation between processes.

Table 1. Evaluated Domains and Processes of COBIT 2019

Domain COBIT 2019	Process Code	Process Description
APO	APO01	Management of IT Management Framework
APO	APO12	IT Risk Management
DSS	DSS01	IT Risk Management
DSS	DSS02	IT Incident Management
DSS	DSS04	Service Continuity Management

"The evaluation of the IT process capability level in this study is focused on the APO and DSS domains of COBIT 2019. The processes analyzed are presented in Table 1."

In the APO domain, processes related to IT risk planning and management show a relatively better level of capability compared to processes related to IT communication management. This indicates that the organization has a planning framework and basic policies in place, but they have not yet been fully and consistently implemented in post-disaster emergency situations. The limitations in inter-unit coordination and the suboptimal emergency

communication mechanisms based on IT are factors that affect the achievement of capabilities in this domain.

Table 2. Results of COBIT 2019 Process Capability Level Measurement

Process Code	Actual Capability	Level Target Capability Level	Category
APO01	3 (Defined)	4 (Managed)	Enough
APO12	3 (Defined)	4 (Managed)	Enough
DSS01	4 (Managed)	4 (Managed)	Good
DSS02	3 (Defined)	4 (Managed)	Enough
DSS04	2 (Managed)	4 (Managed)	Lacking

The results of measuring the IT process capability level based on COBIT 2019 show variations in achievement among processes. The details of the measurement results are presented in Table 2.

In the DSS domain, the operational processes of IT services and incident handling show varying levels of capability. The service disruption handling process generally follows procedures, but delays in recovering IT infrastructure have been observed due to resource limitations and significant physical damage. The service continuity and system recovery processes show a lower level of capability compared to daily operational processes, indicating the need to strengthen post-disaster IT recovery strategies and mechanisms.

3.3 Gap Analysis

Table 3. Gap Analysis

Process Code	Actual Level	Actual Level	Target Level Gap
APO01	3	4	1
APO12	3	4	1
DSS01	4	4	0
DSS02	3	4	1
DSS04	2	4	2

The comparison between the actual capability level and the expected capability level results in several gaps. The results of the gap analysis are presented in Table 3. The gap analysis was conducted by comparing the actual capability level obtained from the measurement results with the expected capability level. The analysis results indicate the presence of gaps in most of the evaluated processes, particularly in processes related to emergency IT communication and service continuity. The largest gaps were found in processes that require cross-unit coordination and rapid response, such as incident management and post-disaster communication. This condition indicates that although policies and procedures are available, their implementation in the field has not been fully effective in handling crisis situations. The gap indicates the need for improved integration between the planning, implementation, and evaluation of IT governance, particularly in the context of disasters.

3.4 Results of Qualitative Analysis

Table 4. Summary of Qualitative Findings

Aspect	Main Findings
Emergency Communication	The communication flow has not been well documented.
Infrastructure Recovery	Limited backup devices
SDM TI	Limited quantity and competence
Coordination	Post-disaster evaluation is not yet structured.

Qualitative data analysis yields several key themes that affect the effectiveness of communication and IT infrastructure recovery post-disaster. A summary of the qualitative findings is presented in Table 4.

The results of the qualitative analysis reveal several key themes that influence the effectiveness of communication and IT infrastructure recovery post-disaster. The first theme relates to emergency communication mechanisms, where informants stated that the communication flow has not been fully documented and still relies on individual initiatives. This causes delays in information delivery and lack of synchronization between units.

The second theme relates to the readiness of infrastructure and IT resources. Informants revealed that the limitations of backup devices, the vulnerability of data center locations, and the shortage of IT personnel trained in disaster management are the main obstacles in the recovery process. The third theme relates to coordination and decision-making, where the absence of a structured post-disaster evaluation mechanism has resulted in suboptimal organizational learning.

3.5 Integration of Quantitative and Qualitative Findings

The integration of quantitative and qualitative results shows consistency between the low capability levels in several COBIT 2019 processes and the field findings revealed thru interviews and documentation studies. Processes with low capability levels tend to face significant implementation challenges, such as the lack of tested emergency communication SOPs and limited IT recovery resources. Conversely, processes with relatively higher capability levels are supported by more structured practices and the organization's experience in handling previous disruptions. This integration strengthens the validity of the research findings and demonstrates that the mixed-method approach is capable of providing a more comprehensive picture of the post-disaster IT governance conditions.

3.6 Summary of Research

Results Overall, the research results indicate that the effectiveness of communication and IT infrastructure recovery post-flood and landslide disasters in Sumatra in 2025 is still at a level that requires improvement. Although the organization has a foundation of IT governance and management, the implementation in crisis situations has not been fully optimal. These findings underscore the importance of strengthening IT governance based on COBIT 2019, integrated with emergency communication practices and IT infrastructure recovery strategies that are more adaptive to disaster conditions.

3.7 Discussion

The results of this study indicate that the effectiveness of communication and the recovery of Information Technology (IT) infrastructure post-flood and landslide disasters in Sumatra in 2025 are still at a level that requires improvement. Based on the measurement results of process capabilities using the COBIT 2019 framework, most processes in the Align, Plan, and Organize (APO) and Deliver, Service, and Support (DSS) domains are at the defined to managed level. These findings indicate that the organization has basic policies and procedures related to IT management, but their implementation has not been fully consistent and optimal in facing crisis conditions due to disasters.

In the aspect of post-disaster IT communication, the research findings indicate that the planning and management processes of communication have not yet been fully integrated into the IT governance framework. This aligns with previous research findings that state that communication failures in emergency situations are often caused by weak cross-unit coordination and the absence of tested emergency communication mechanisms. Although the organization has formal communication channels, their effectiveness decreases when there are infrastructure disruptions and resource limitations, thereby slowing down the process of information delivery and decision-making.

Findings in the DSS domain, particularly those related to incident handling and IT service continuity, indicate that the recovery of IT infrastructure still faces various obstacles. The relatively lower capability level in the service continuity process indicates that the IT recovery strategy is not yet fully prepared to handle the impact of large-scale disasters. This condition is consistent with the literature that emphasizes the importance of disaster recovery planning and the provision of backup resources as key factors in maintaining IT service continuity. The limitations of backup devices and the vulnerability of infrastructure locations to disasters are the main factors affecting the speed of system recovery.

The integration of quantitative and qualitative findings strengthens the results of this research. Processes that show low capability levels quantitatively were also identified as having significant implementation constraints based on interview results and documentation studies. This indicates that COBIT 2019-based measurements are capable of reflecting real conditions in the field, while also confirming that the mixed-method approach provides a more comprehensive picture compared to the use of a single method. This approach allows researchers to not only identify the capability levels of IT processes but also understand the contextual factors that influence the effectiveness of communication and IT recovery postdisaster.

From the perspective of IT governance, the results of this study affirm that the implementation of COBIT 2019 in a post-disaster context can be an effective evaluation tool to identify gaps between existing practices and expected practices. The identified gap analysis indicates the need to strengthen the integration between planning, execution, and evaluation of IT governance, particularly in supporting disaster preparedness and response. These findings are consistent with previous research that states that mature IT governance significantly contributes to an organization's resilience in facing external disruptions.

Overall, this discussion emphasizes that the effectiveness of communication and postdisaster recovery of IT infrastructure is not only determined by the availability of technology but also by the quality of governance, the readiness of human resources, and the organization's ability to integrate policies with operational practices. Thus, enhancing IT process capabilities based on COBIT 2019, supported by contextual understanding thru a mixed-method approach, becomes a strategic step to improve the IT resilience of organizations in disaster-prone areas.

Conclusion

This research shows that the effectiveness of communication and the recovery of Information Technology infrastructure post-flood and landslide disasters in Sumatra in 2025 are still at a level that requires significant improvement. Based on the evaluation using the COBIT 2019 framework, most processes in the Align, Plan, and Organize as well as Deliver, Service, and Support domains are at the defined to managed capability level. These findings indicate that the organization has basic policies and procedures in place, but their implementation in crisis situations has not been fully consistent and integrated. The analysis results reveal that the main weaknesses lie in the aspects of emergency communication and the continuity of IT services, characterized by limited cross-unit coordination, lack of tested communication mechanisms, and limited resources supporting IT infrastructure recovery. The integration of quantitative and qualitative findings shows the alignment between the level of IT process capabilities and the actual conditions on the ground, thereby strengthening the validity of this research. Theoretically, this research contributes to enriching the literature on IT governance in the context of disasters by demonstrating the relevance of COBIT 2019 as a tool for evaluating the effectiveness of communication and IT infrastructure recovery post-disaster. Practically, the results of this research provide a basis for strategic recommendations for organizations in disaster-prone areas to strengthen IT preparedness and resilience. Further research is recommended to expand the scope of the area, compare across sectors, and integrate advanced quantitative approaches to deepen the analysis of information system resilience to disasters.

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