Vol. 8, No. 1, February 2026

ISI Journal of Information Systems and Informatics

Published By Asosiasi Doktor Sistem Informasi Indonesia

A Web-Based Disaster Report Recapitulation System Using the Simple Additive Weighting Method

Fanuel Juventino Palandeng[1], Sondy Campvid Kumajas[2], Kristofel Santa[3]

[1,2,3]Informatics Engineering, Faculty of Engineering, Manado State University, Minahasa, Indonesia

Received:
November 17, 2025
Revised:
January 12, 2026
Accepted:
January 28, 2026
Published:
February 24, 2026

Corresponding Author:
Author Name*:
Fanuel Juventino Palandeng
Email*:
22210028@unima.ac.Id

DOI:
10.63158/journalisi.v8i1.1410

Abstract. Many regional disaster management agencies still manage incident reporting through conventional, semi-manual workflows (e.g., spreadsheets and paper archives). These practices often create repetitive recapitulation tasks, increase the likelihood of data inconsistency, and produce reports that remain largely descriptive—limiting analytical support for timely, evidence-based decision-making. To address this limitation, this study develops a web-based disaster reporting and recapitulation system integrated with the Simple Additive Weighting (SAW) method to generate an event-level Impact Index for prioritization. The system is built using a Prototyping approach, enabling iterative refinement through user feedback to ensure operational fit. SAW is applied using weighted criteria—number of casualties, affected families, damage level, and disaster type—so that each recorded event can be scored and ranked automatically. In contrast to many prior disaster-related SAW applications that emphasize beneficiary selection or aid distribution, this research applies SAW for internal managerial evaluation, prioritizing disaster events themselves to support organizational review and mitigation planning. A case study at BPBD Minahasa Regency demonstrates the system's feasibility and performance: Black Box Testing achieved a 100% functional success rate, and manual SAW verification confirmed that automated Impact Index outputs are mathematically consistent with theoretical calculations. Overall, the proposed application offers a structured and transparent analytical tool to standardize reporting, accelerate recapitulation, and strengthen decision support through objective impact-based ranking.

Keywords: Disaster management, Decision support, SAW, Web system, Prototyping

1. INTRODUCTION

In the modern era, information technology has reshaped how organizations plan, coordinate, and evaluate their operations by reducing the mismatch between resource demand and resource availability. Digital archiving and information systems are no longer optional tools; they are increasingly essential infrastructures that strengthen organizational capacity, improve transparency, and support strategic decision-making through timely, structured, and retrievable data [1], [2]. This capability becomes even more consequential in disaster management, where decisions must often be made under uncertainty and time pressure, and where delays or inaccuracies in information can directly affect the effectiveness of policy formulation, response coordination, and resource allocation [3]. Although the Regional Disaster Management Agency (BPBD) is positioned as a key actor in these processes, many regional offices continue to experience persistent obstacles in moving from manual procedures to digital, analytics-enabled workflows [4].

In Minahasa Regency, BPBD's disaster data management is still dominated by conventional practices. Disaster events—covering critical attributes such as location, time, hazard type, and victim counts—are recorded through manual recapitulation in Microsoft Excel and then stored as physical archives. While this approach may appear workable for routine documentation, it introduces three structural problems for operational decision-making. First, the workflow is labor-intensive and repetitive, increasing administrative burden and limiting staff time for analysis and preparedness planning. Second, the reliance on manual input creates high exposure to inconsistencies and errors, especially when the same data must be copied, reformatted, and aggregated across different reporting periods. Third, and most importantly, the reporting output remains largely descriptive: it typically summarizes incidents as counts and narrative recaps, without providing analytical instruments to quantify severity or compare events consistently. As a result, mitigation evaluation and prioritization often depend on subjective judgments or informal estimations rather than mathematically derived impact measures, increasing the risk of bias and slowing decision cycles that should be evidence-driven [5]. In practical terms, this means that the agency may have data, but lacks an objective mechanism to convert that data into actionable priorities—particularly when multiple events compete for limited resources.

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

This study responds to that operational gap by proposing a Decision Support System (DSS) that applies the Simple Additive Weighting (SAW) method to transform existing disaster event data into structured decision information. Decision support systems are widely recognized for their role in assisting decision-makers by processing data into relevant, usable insights that improve decision quality in semi-structured or unstructured contexts [6]. SAW, as a Multi-Attribute Decision Making (MADM) technique, offers a straightforward weighted-summation approach that can combine multiple criteria into a single comparable score [7]. Its practicality and reliability have been demonstrated across diverse ranking applications, including personnel management [8], marketing staff selection [9], and device selection [10], as well as broader administrative decision-support and evaluation contexts [11]. These characteristics make SAW particularly attractive for agencies that require methods that are not only computationally sound but also easy to explain, validate, and operationalize in day-to-day decision routines.

The selection of SAW over other established MADM methods such as the Analytic Hierarchy Process (AHP) and TOPSIS is motivated by operational suitability and interpretability. SAW produces rankings through a linear weighted mechanism in which the contribution of each criterion remains explicit and traceable in the final score, enabling decision-makers to understand "why" an event receives a higher or lower priority [12], [13]. In contrast, AHP depends heavily on repeated subjective judgments expressed through pairwise comparison matrices; even with automated consistency checks, the method can impose significant iterative input demands, which may be impractical in high-frequency reporting or time-sensitive disaster management environments and may raise the risk of inconsistent assessments across evaluators or periods [14]. TOPSIS, while powerful and automatable, ranks alternatives based on distance to ideal and anti-ideal solutions; the embedded nature of criterion influence within distance calculations can reduce transparency for non-technical users who need clear, auditable reasoning behind prioritization outcomes [15]. Therefore, SAW provides an appropriate balance between analytical rigor and operational clarity for regional agencies aiming to standardize evaluations without overcomplicating implementation.

Although prior research has demonstrated SAW's usefulness in disaster-related decision problems—such as identifying recipients for post-earthquake housing assistance [16] and selecting flood evacuation routes [17]—a notable gap remains in how SAW has been

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

positioned within disaster management practice. Existing studies predominantly emphasize the emergency response phase and focus on ranking beneficiaries or spatial alternatives. Limited attention has been given to applying SAW for internal managerial evaluation of disaster events themselves, where the objective is not to choose who receives aid or which route to take, but to systematically assess and compare the severity of multiple disaster occurrences to guide organizational prioritization. This gap is particularly relevant for local disaster management offices, which must routinely decide which events warrant deeper investigation, stronger mitigation follow-up, or priority allocation of preparedness resources.

Accordingly, this research offers a novel contribution by extending SAW from beneficiary-oriented ranking toward event-oriented evaluation. Rather than ranking individuals or locations for intervention, the proposed DSS ranks disaster events using an event-level Impact Index, enabling BPBD to quantify severity objectively and consistently across time and incident types. This contribution is twofold: conceptually, it reframes SAW as a tool for macro-level internal prioritization in disaster governance; practically, it delivers a web-based decision support tool aligned with the operational workflow of BPBD Minahasa, supporting faster, more transparent, and more defensible mitigation planning and organizational decision-making.

2. METHODS

To ensure the study was executed in a clear, traceable, and repeatable manner, the research activities were organized into a sequential yet iterative workflow, as depicted in Figure 1. This flow was designed to connect field needs with system development outputs, starting from problem identification and data acquisition, then moving into analysis and system design. The process continues through an iterative prototyping cycle to refine requirements and functionality based on ongoing evaluation, and concludes with testing and implementation to validate that the developed decision support system meets both technical requirements and operational needs. By following these stages, the research maintains methodological rigor while allowing practical adjustments throughout development, ensuring the final system is aligned with BPBD's real-world reporting and decision-making processes.

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

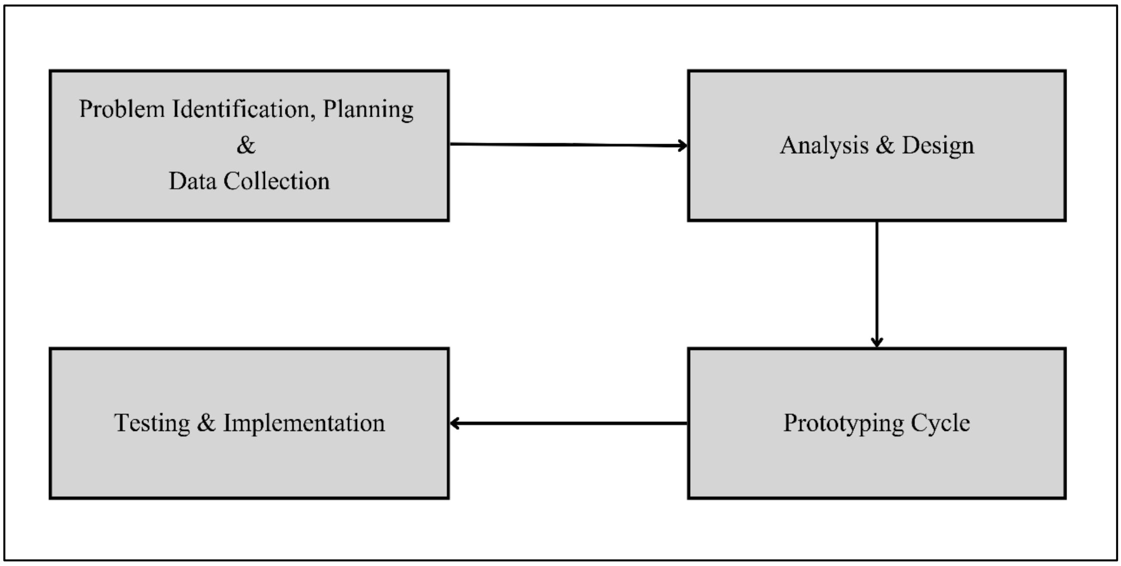

Figure 1. Research Flow

To ensure a structured implementation and reproducible results, this research followed the systematic stages illustrated in Figure 1. The workflow was designed to move from field-level problem discovery to a validated decision-support output, while still allowing iterative refinement through prototyping. Each stage produces specific deliverables that become inputs for the next stage, ensuring traceability from initial requirements to the final "Impact Index" ranking produced by the system. The detailed explanation of each stage is as follows:

1) Problem Identification and Data Collection: The research began with identifying the core issues at BPBD Minahasa, specifically the latency and inconsistency in manual disaster reporting. Data was collected through three methods: Observation of the current Excel-based workflow; semi-structured interviews and literature study to formulate the theoretical basis for the Simple Additive Weighting (SAW) algorithm and align criteria with Law of the Republic of Indonesia Number 24 of 2007 on Disaster Management.
2) System Analysis and Design: In this phase, the collected data was translated into technical specifications. This involved two parallel processes: defining the SAW Logic (determining criteria C1-C4 and their weights based on the interviews) and System Modeling (designing the database schema, Use Case diagrams, and User Interface mockups).
3) Prototyping Development Cycle: The system was constructed using the Prototyping method, which relies on an iterative feedback loop. An initial version was developed

and presented to the users. During the user evaluation, feedback was gathered. The system then entered the refinement stage, where the code was modified to address this feedback before producing the final version.

4) System Testing and Validation: Before implementation, the system underwent rigorous testing. Black Box Testing was conducted to verify that all functional requirements (Login, CRUD, Export) operated correctly. Simultaneously, a validation test was performed by comparing the system's automated SAW rankings against a manual calculation to ensure the "Impact Index" was mathematically accurate.

2.1 Data Collection

Data collection was conducted using three complementary techniques to ensure that system requirements were grounded in real operational needs and supported by a defensible theoretical basis:

1) Observation: Direct observation was performed at the BPBD Minahasa Office to map the existing manual workflow and identify specific bottlenecks in the Excel-based reporting process.
2) Interviews**:** Semi-structured interviews were conducted with two key personnel to capture both strategic and operational requirements: The Head of the Emergency Section was interviewed to define the decision-making criteria and validate the weighting hierarchy based on legal standards. The Technical Staff was interviewed to identify daily operational pain points, specifically regarding data entry errors and user interface needs. During these sessions, the Head of the Emergency Section explicitly instructed the researcher to formulate the initial weighting criteria based on the legal mandates of Law of the Republic of Indonesia Number 24 of 2007 on Disaster Management. Following the directive, the derived criteria were presented back to the Head of Agency for confirmation and justification to ensure they aligned with the agency's operational standards before being implemented into the system.
3) Literature Study: A review of theoretical frameworks and legal statutes was conducted to support the system design. This involved analyzing the mathematical principles of the Simple Additive Weighting (SAW) algorithm to ensure correct implementation and reviewing Law of the Republic of Indonesia Number 24 of 2007 on Disaster Management to align the system's prioritization logic with national disaster management standards.

2.2 System Development Method

This research adopts the Prototyping method for system development. This approach is characterized by its iterative nature, where an initial system version is developed and evaluated by users to obtain feedback for continuous refinement. Prior studies in document management systems highlight the importance of aligning system functionality with operational needs to improve efficiency and reporting accuracy [18]. The Prototyping method facilitates rapid adjustments to interface design and system functionality based on direct user input, thereby reducing the risk of project failure [19].

The Prototyping method is particularly effective for developing web-based administrative systems as it ensures the final application aligns closely with user requirements through continuous interaction, as demonstrated in the development of similar archiving systems [20]. The process consists of five systematic steps [19].

1) Requirement Identification: This stage focuses on gathering information to define the scope and specifications of the system. In-depth interviews were conducted to understand the application workflow and features expected by the BPBD staff.
2) System Design: This stage involves creating a system blueprint prior to implementation. The focus is placed on visual interface design, core feature definition, and system workflow modeling using Use Case Diagrams to represent functional interactions and Activity Diagrams to describe procedural logic.
3) Initial Prototype Development: The design is translated into a preliminary software representation. Implementation is carried out using HTML, CSS, Javascript, and PHP, resulting in a simple application ready for testing.
4) Prototype Evaluation: The initial application model is tested directly by users. This step is crucial to identify any discrepancies between the system functions and user expectations.
5) Prototype Modification: Based on the evaluation results, the prototype is revised. This process is repeated until the final prototype is fully approved by the users.

The corresponding outputs of each of these steps can be seen In Table 1.

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

Table 1. Prototyping Stages & Outputs

Stage	Specific Output
Requirement Identification	Functional & non-functional requirements list
System Design	UML Diagrams (Use Case, Activity), Database Schema, UI Mockups
Initial Prototype Development	First version of application
Prototype Evaluation	List of revision requirements, Initial Black Box test results
Prototype Modification	App modifications (Incident table, filters), first reliable version

2.4 Implementation of Simple Additive Weighting

The core logic of the Decision Support System (DSS) in this project is built upon the Simple Additive Weighting (SAW) algorithm. This method was chosen for its ability to provide precise assessments based on criteria values and predetermined preference weights [16]. Comparative studies suggest that SAW is often superior for assessment transparency and simplicity compared to more complex methods like TOPSIS, making it suitable for organizational decision-making [21]. Furthermore, Purba has successfully demonstrated the robustness of SAW in ranking alternatives in educational personnel settings, a logic that transfers well to the ranking of disaster priorities where objective criteria are Important [22]. This ranking capability is further supported by similar studies in employee selection, which validate SAW's effectiveness in hierarchical prioritization tasks [23]. To determine the disaster impact priority, the system applies the following SAW steps:

1) Determining Criteria and Weights

This stage involves defining the specific attributes used for decision-making. Subjectivity in weight assignment is a known challenge. To mitigate this, the researcher avoided arbitrary assumptions by deriving weights from the priority hierarchy in Law (UU) No. 24 of 2007, which explicitly prioritizes the protection of human life over material assets. These proposed weights were validated by the Head of the Emergency Section to ensure alignment with agency standards. The final configuration is:

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

a) C1: Casualties (Weight 0.40): Selected as the primary criterion because the number of victims is the most critical indicator of disaster severity. This aligns with the principle of prioritizing life safety in disaster management above all other metrics.

b) C2: Affected Families (Weight 0.25): Selected to measure the breadth of social impact. This criterion is essential for calculating logistical needs (evacuation centers, food supplies) and assessing the disruption to community stability.

c) C3: Damage Level (Weight 0.20): Selected to represent physical loss at the event level. To minimize subjectivity in field reporting, damage categories follow BNPB technical guidelines, where Heavy indicates structural collapse or major structural failure, Moderate refers to non-structural damage that affects functionality, and Light represents minor defects such as cracks or roof damage. In events involving multiple buildings with varying damage severity, the assigned damage level reflects the highest observed damage category to support rapid managerial prioritization. This qualitative assessment is then converted into a quantitative scale for SAW processing: Heavy (3), Moderate (2), and Light (1).

d) C4: Disaster Types (Weight 0.15): Disaster types are weighted based on operational urgency rather than formal risk classification. Earthquakes are assigned the highest score (4) due to their unpredictability, potential for mass structural collapse, and cascading secondary hazards. Landslides and forest fires receive a score of 3, reflecting high fatality potential and rapid escalation characteristics. Floods and residential fires are assigned a moderate score (2) as their impacts are often localized or develop progressively. Strong winds are given the lowest score (1) because they typically result in superficial, non-structural damage.

2) Matrix Normalization (R)

Since all criteria are considered "benefit" attributes (where higher values indicate higher priority/impact), the normalization formula used is shown in Equation 1.

$$r_{ij} = \frac{x_{ij}}{\max(x_{ij})} \quad (1)$$

Where:

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

r_{ij} = The normalized performance rating.

x_{ij} = The attribute value for each alternative.

$max\ (x_{ij})$ = The maximum of each criterion.

3) Ranking and Preference Value (V_i)

After normalization, the final preference value for each disaster event is computed using the weighted summation shown in Equation 2. This produces the "Impact Index" used for prioritization, where the contribution of each criterion remains directly traceable through its weight and normalized value.

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \quad (2)$$

Where:

V_i = The final value (preference) of the alternative.

W_j = The weight determined for the criterion j.

r_{ij} = The normalized matrix value.

The disaster event with the highest V_i value is interpreted as having the highest impact priority and therefore requires greater managerial attention for evaluation, follow-up, and mitigation planning.

3. RESULTS AND DISCUSSION

3.1. System Requirement Identification

The first outcome of this research is the formulation of system requirements derived directly from field observations and stakeholder interviews. The requirement identification process was driven by the core operational problems found at BPBD Minahasa: (1) slow reporting cycles caused by repetitive manual recapitulation, (2) frequent inconsistencies due to re-entry of similar data across documents, and (3) the absence of an objective mechanism to assess and compare disaster-event severity beyond descriptive incident counts. Translating these issues into a system specification, the proposed application is required to: provide secure access control, support structured disaster data management, and automatically generate an event-priority ranking using the Simple Additive Weighting (SAW) method as soon as relevant attributes are entered.

In addition to functionality, the system must reflect BPBD's real decision workflow by separating responsibilities between user roles. Field Staff require an interface optimized for fast and accurate data entry (including correction and updates), while the Head of Agency requires capabilities for validation (approve/reject) and decision-oriented outputs such as ranked recapitulation reports. This separation reduces the risk of unauthorized changes, improves accountability, and ensures that managerial decisions are based on verified records. The resulting functional and non-functional requirements are summarized in Table 2.

Table 2. Functional & Non-Functional Requirements

No	Category	Requirement	Description
1	Functional	Authentication	Secure login for Staff and Head of Agency
2	Functional	CRUD Operations	Capabilities to Create, Read, Update, and Delete Disaster Reports
3	Functional	SAW Calculation	Automated computation of Impact Index upon data entry.
4	Functional	Validation Logic	Workflow for the Head to Approve/Reject reports.
5	Functional	Reporting	Export/Print functionality for recapitulation.
6	Non-Functional	Accessibility	Web-based project accessible via standard browsers.
7	Non-Functional	Usability	Minimalist interface suitable for non-technical staff.
8	Non-Functional	Performance	Real-time calculation of rankings (< 2 seconds).

3.2. System Design

3.2.1. Database Design

The database design was developed to ensure that disaster records are stored consistently, can be retrieved efficiently, and remain traceable for validation and reporting purposes. The system uses MySQL as the relational database management system because it supports structured data modeling, relationship enforcement through keys, and reliable transaction handling for web-based administrative applications. The

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

schema is organized into three core tables, each with a distinct role in supporting the workflow:

1) The users table stores credential and role information required for authentication and authorization, ensuring that access rights differ between Field Staff and the Head of Agency.
2) The disasters table functions as the primary transaction table, containing event-level disaster details (e.g., location, time, disaster type) as well as the attributes required for SAW processing and the resulting "Impact Index." This design ensures that ranking outputs are directly tied to the same record used for operational reporting, avoiding duplicate calculations stored elsewhere.
3) The disaster_photos table is dedicated to storing photo evidence associated with each disaster event. This table is connected to the disasters table using a foreign key relationship to enforce referential integrity—meaning photo records cannot exist independently without a corresponding disaster record. This relationship is important operationally because evidence must remain strictly attached to the event it documents, supporting verification and reducing ambiguity during validation.

To further reduce input errors—one of the key weaknesses of the current manual process—basic validation mechanisms are implemented at the user interface level. HTML5 form constraints provide immediate feedback to users by preventing empty submissions via required attributes and enforcing numeric formats where appropriate. While client-side validation does not replace database-level integrity rules, it acts as an effective first barrier against incomplete or incorrectly formatted entries, improving data quality at the point of capture. The overall structural relationships among these entities are illustrated in Figure 2.

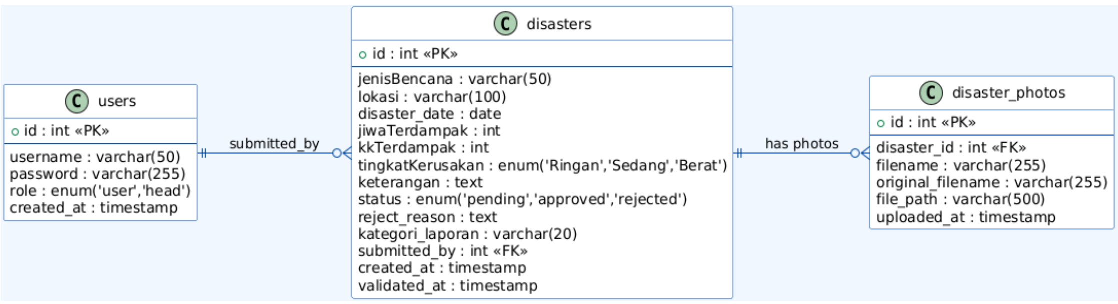

Figure 2. Database Schema

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

3.2.2. System Modeling

System modeling was carried out to translate user requirements into clear interaction structures and process logic, ensuring that the application supports BPBD's reporting workflow in a controlled and auditable manner. Two complementary models were produced: a Use Case Diagram to describe who interacts with the system and what functions they can access, and an Activity Diagram to describe how the end-to-end business process flows from data entry to validation and ranking output.

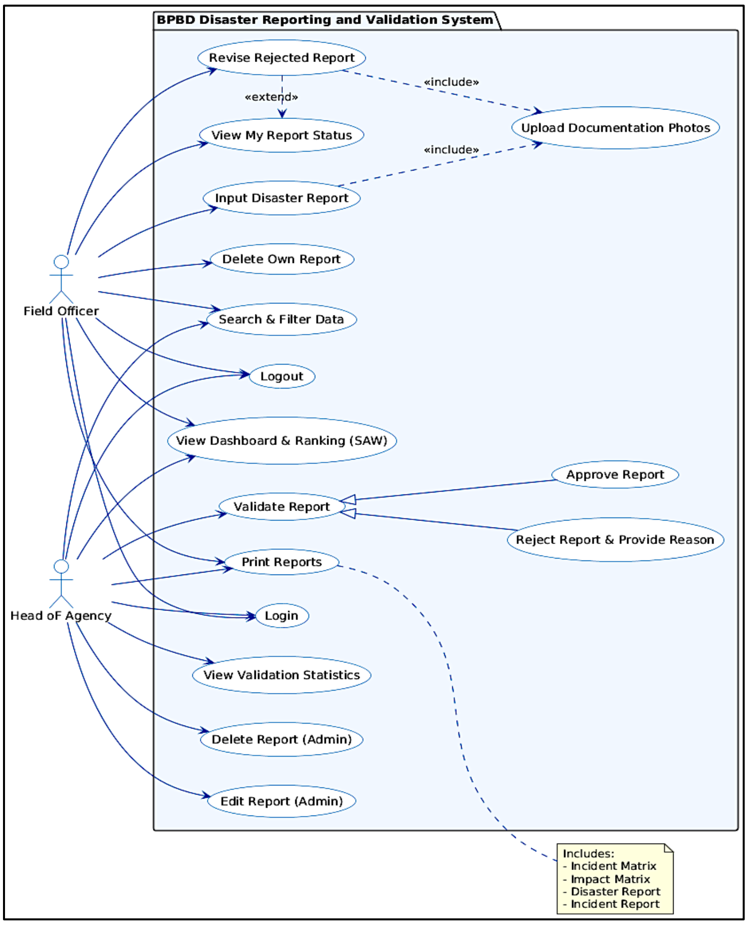

Figure 3. Use Case Diagram

Figure 3 presents the Use Case Diagram. The diagram is used to identify the system actors and map their interactions with the application's core services. In this system, two primary actors are defined: the Field Officer and the Head of Agency. The Field Officer is responsible for operational reporting activities, including entering disaster event data, updating records when corrections are needed, and managing supporting documentation such as photo evidence. The Head of Agency performs supervisory and decision-oriented functions, including reviewing submitted reports, validating their credibility, and managing outputs for recapitulation and prioritization. By explicitly separating these interactions, the Use Case Diagram clarifies role boundaries, reinforces accountability, and ensures that verification authority remains with the appropriate decision-maker.

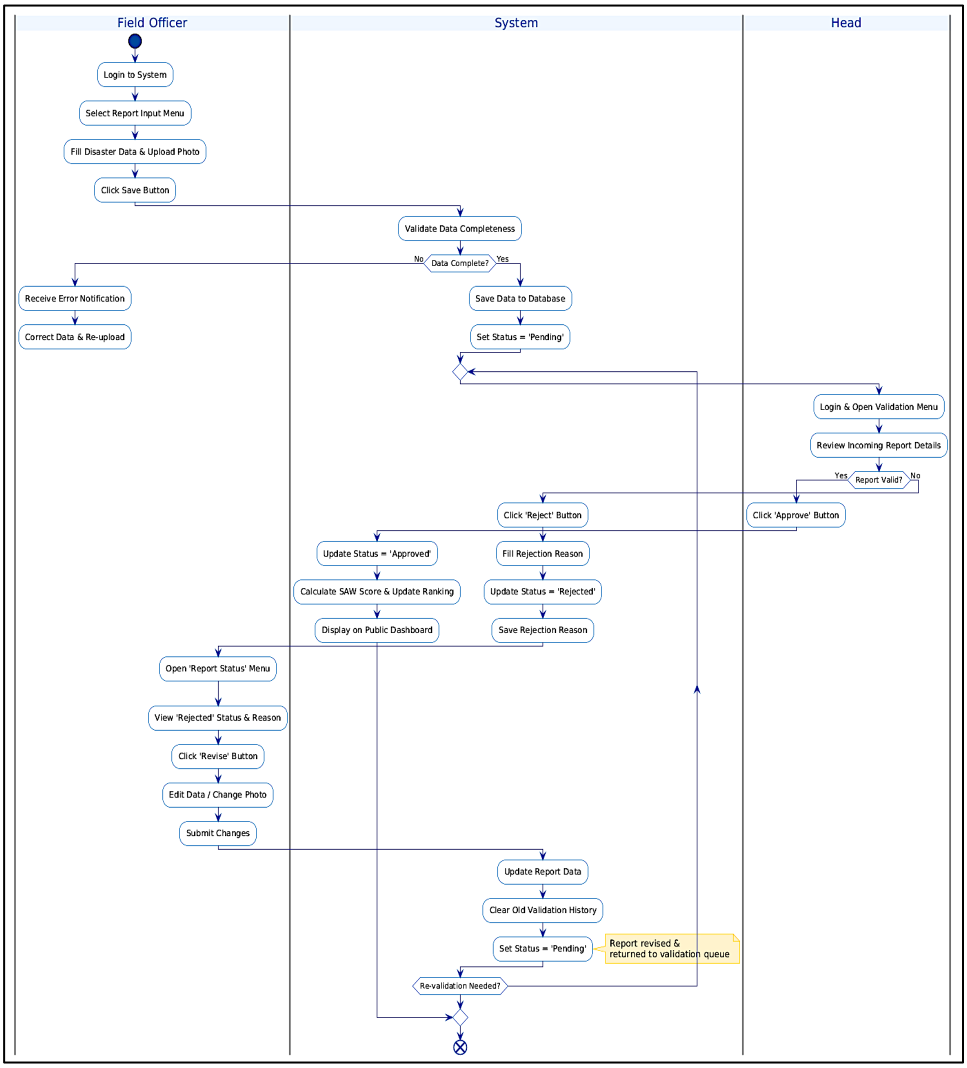

Figure 4. Activity Diagram

Figure 4 illustrates the Activity Diagram, which models the workflow and business processes of the proposed system. The activity flow is organized into three swim lanes—Field Officer, System, and Head of Agency—to show how responsibilities shift across actors and how decision points determine the next step in the process. The workflow begins when the Field Officer submits a disaster report through the system interface. The System then performs an initial completeness check to ensure required fields are

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

provided; submissions that pass this check are stored and assigned a Pending status. Next, the Head of Agency reviews the incoming reports and makes a validation decision: approve or reject. Approved reports proceed to the decision-support stage, where the system triggers SAW computation, generates the event-level "Impact Index," and updates the ranking list accordingly. Rejected reports are returned to the Field Officer with the rejection status, enabling revision and resubmission without compromising traceability. This structured loop ensures that data quality is controlled before decision outputs are produced, while also supporting continuous correction and improvement of field submissions. As a result, the system workflow integrates three critical controls in one pipeline: standardized reporting, managerial validation, and consistent, repeatable prioritization.

3.3. Initial Prototype Development

To avoid overwhelming the discussion with too many interface screenshots, only the most operationally critical prototypes are highlighted in this section: the Staff Dashboard (data entry + recapitulation), the Report Status page (submission tracking), the Validation interface (approval control), and the SAW output display (Impact Index). These components represent the core workflow from field reporting to managerial decision support. Figure 5 presents the Staff Dashboard, which functions as the main operational workspace for daily reporting. The interface is intentionally designed in a split-view layout to support speed and reduce context switching. On the left, the system provides an input form that dynamically adapts to the selected report category (e.g., Natural Disaster versus Emergency Incident), ensuring that users only see fields relevant to the selected case type. This reduces input clutter and lowers the risk of missing required attributes. On the right, a recapitulation table displays submitted records in real time, allowing staff to immediately confirm that entries have been stored correctly and to quickly identify which events have been recorded most recently.

As shown in Figure 5, the Natural Disaster list includes an automatically generated "Impact Index" column produced by the SAW computation. This feature transforms the table from a passive archive into a decision-oriented view, because the system ranks disaster events based on calculated severity rather than listing them only chronologically. In practical terms, once a record is entered with complete criteria values, staff can instantly see whether the event rises to the top of the priority list, which supports faster

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

escalation and internal coordination. In contrast, Emergency Incidents are displayed without SAW scoring and are arranged chronologically to preserve administrative simplicity for routine, low-impact cases. This separation prevents frequent minor incidents from cluttering the prioritization view intended for major disasters, while still maintaining a complete record of operational events.

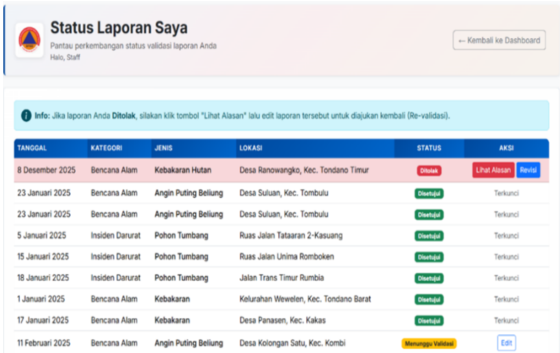

Figure 6. Report Status Page

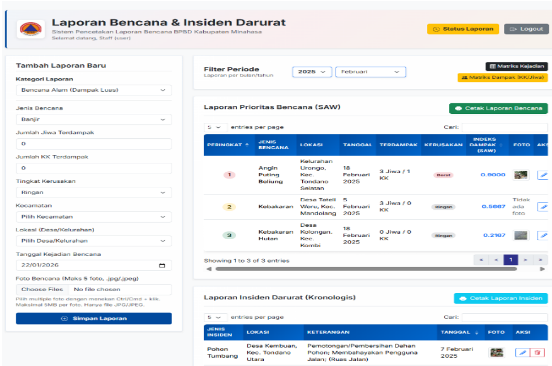

Figure 5. Staff Dashboard Implementation

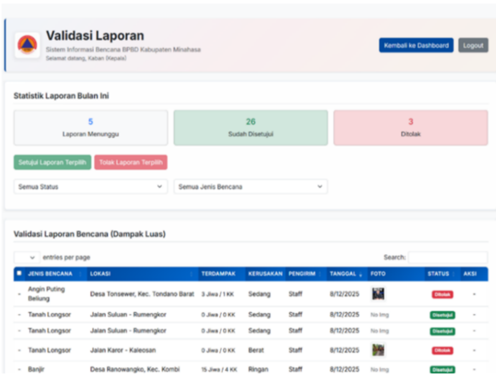

Figure 7. Validation Page Implementation

Figure 6 illustrates the Report Status page, which provides transparency and traceability across the submission lifecycle. Rather than requiring staff to confirm report acceptance through informal communication, the system shows a live list of submissions along with their validation status—Pending (Menunggu), Approved (Diterima), or Rejected (Ditolak). The design uses color-coded badges to support rapid scanning (e.g., yellow for pending, green for approved, red for rejected), making it easy for staff to recognize which reports require follow-up. This page also supports an iterative correction cycle: rejected reports can be revised and resubmitted without forcing users to re-enter the entire dataset, reducing repetitive work while improving data quality over time.

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

Figure 7 presents the Validation Page, which is central to managerial control and accountability. This interface is designed for the Head of Agency to review incoming submissions, verify completeness and plausibility, and then issue an approval decision. Approved records proceed into the decision-support pipeline, while rejected records are returned to field staff with a rejection status, ensuring that only verified data becomes the basis for prioritization and formal reporting. This design strengthens governance by separating data entry from decision authority and ensures that the DSS outputs reflect validated information rather than unconfirmed field inputs.

3.4. Simple Additive Weighting Implementation

The SAW mechanism is embedded directly into the application workflow to ensure prioritization is produced automatically and consistently. As shown in Figure 8, the system generates the Impact Index as an output column within the report table. Operationally, this means users do not need to run separate calculations or export data for external processing; instead, the ranking logic is executed by the system whenever relevant data are loaded and/or confirmed. Internally, the system performs normalization and weighted aggregation to calculate preference values for each alternative, and then updates rankings accordingly. Displaying the Impact Index directly in the table ensures the result is visible at the exact point where decisions are made (review, escalation, and recapitulation), supporting faster prioritization while keeping the scoring outcome auditable at the record level.

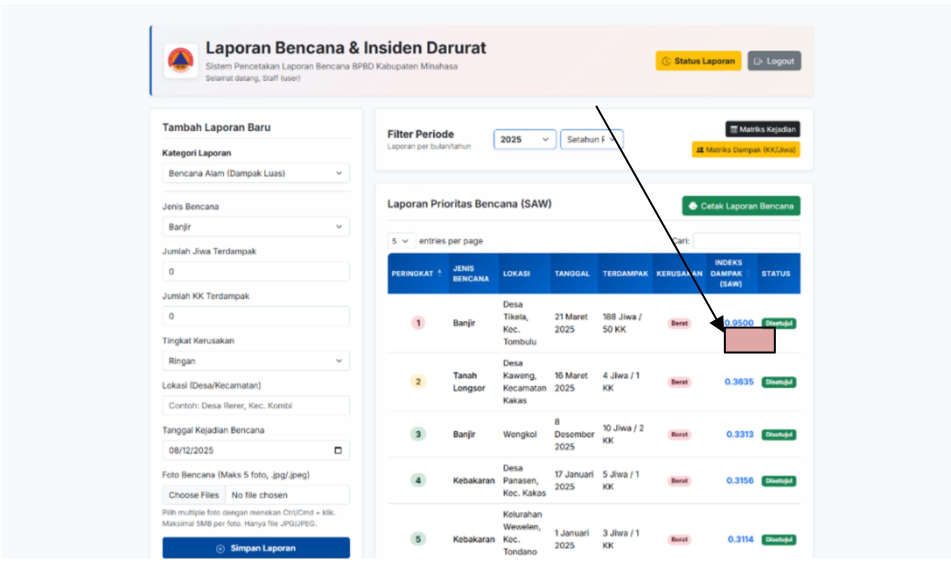

Figure 8. Simple Additive Weighting Implementation

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

3.5. Validation of SAW Calculation

To verify that the implemented SAW algorithm produces correct results, the system output was validated through a manual calculation comparison using a sample dataset of disaster events (March 2025). Figure 9 shows the sample dataset used in this validation step. The purpose of this test is to confirm that the program logic follows the theoretical SAW procedure and that the quantification rules applied to each criterion (including categorical-to-numeric conversions) are consistent with the system configuration. By comparing automated Impact Index values against manually computed results for the same alternatives and criteria weights, the validation process ensures that ranking outcomes are not only functional but also mathematically accurate. This step is essential because even a small implementation error in normalization or weighting could distort priority ordering, which would undermine the system's role as a managerial decision support tool.

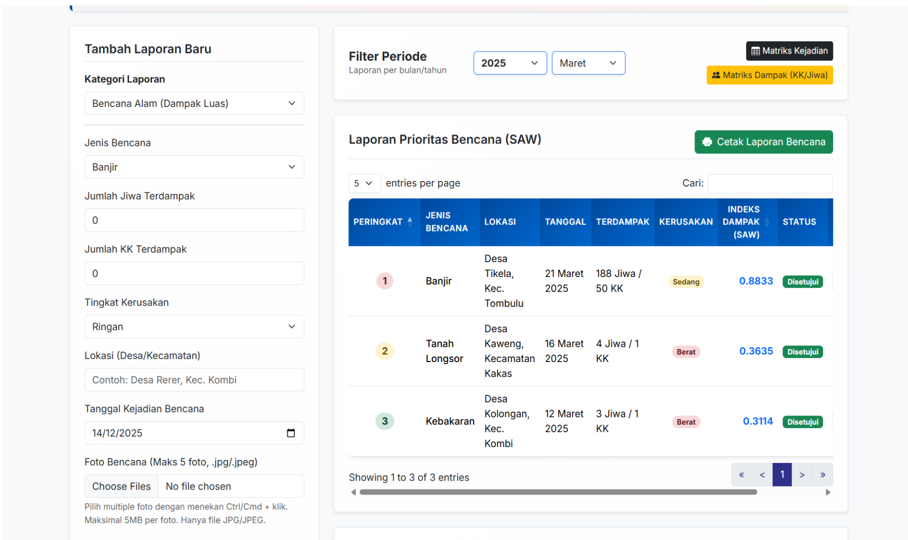

Figure 9. Sample Dataset for SAW Validation

3.5.1. Sample Data (Decision Matrix)

As shown in Table 3, three disaster events were used as alternatives: A1 (Flood), A2 (Landslide), and A3 (Fire). Criteria C1 (Casualties) and C2 (Affected Families) are already quantitative. Meanwhile, C3 (Damage Level) and C4 (Disaster Type) were converted into numeric scores following the system's scoring configuration to ensure consistency between field data and SAW computation. Specifically, Damage Level (C3) is mapped as Heavy/Berat = 3, Moderate/Sedang = 2, and Light/Ringan = 1, while Disaster Type (C4) is

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

mapped as Landslide = 3, Flood = 2, and Fire = 2. This conversion is important because it standardizes qualitative field observations into measurable inputs without changing the operational meaning of the categories.

Table 3. Sample Decision Matrix

Alternative	C1 (Casualties)	C2 (Families)	C3 (Damage Score)	C4 (Type Score)
A1 (Flood)	188	50	2 (Moderate)	2 (Flood)
A2 (Landslide)	4	1	3 (Heavy)	3 (Landslide)
A3 (Fire)	3	1	3 (Heavy)	2 (Fire)
Max Value	188	50	3	3

The corresponding event descriptions are as follows:

1) A1 (Flood in Tikela, 21 March): 188 casualties, 50 affected families, Moderate damage (e.g., houses flooded), Type score = Flood (2).
2) A2 (Landslide in Kaweng, 16 March): 4 casualties, 1 affected family, Heavy damage (e.g., house destroyed), Type score = Landslide (3).
3) A3 (Fire in Kolongan, 12 March): 3 casualties, 1 affected family, Heavy damage (e.g., house burned), Type score = Fire (2).

3.5.2. Normalization Process

After constructing the decision matrix, the next step is normalization to convert all criteria values into comparable performance ratings on a 0–1 scale. Using Equation (1) (benefit normalization), each raw value $x_{ij}$is divided by the maximum value in its criterion column $\max(x_{ij})$. Because all criteria are treated as benefit attributes (higher values indicate higher impact priority), this approach ensures that the alternative with the largest value for a criterion receives a normalized score of 1.00, while other alternatives receive proportional scores.

1) For A1 (Flood):

$$r_{11} = 188/188 = 1.00$$
$$r_{12} = 50/50 = 1.00$$
$$r_{13} = 2/3 \approx 0.6667$$
$$r_{14} = 2/3 \approx 0.6667$$

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

2) For A2 (Landslide):

$$r_{21} = 4/188 \approx 0.0213$$
$$r_{22} = 1/50 = 0.02$$
$$r_{23} = 3/3 = 1.00$$
$$r_{24} = 3/3 = 1.00$$

3) For A3 (Fire):

$$r_{31} = 3/188 \approx 0.0160$$
$$r_{32} = 1/50 = 0.02$$
$$r_{33} = 3/3 = 1.00$$
$$r_{34} = 2/3 \approx 0.6667$$

Table 4 highlights how normalization preserves the *relative strength* of each alternative per criterion. A1 dominates C1 and C2 because it has the highest number of casualties and affected families. Conversely, A2 and A3 dominate C3 due to Heavy damage (score 3), while A2 also dominates C4 because Landslides are assigned the highest type score in this configuration. This makes the trade-off visible: some events are severe due to human impact (A1), while others score high due to damage and hazard type (A2/A3). Normalization is what allows these different "units" (people counts versus categorical severity) to be compared consistently inside a single SAW computation.

Table 4. Normalized Matrix

Alternative	C1 (Casualties)	C2 (Families)	C3 (Damage Score)	C4 (Type Score)
A1	1.00	1.00	0.67	0.67
A2	0.02	0.02	1.00	1.00
A3	0.02	0.02	1.00	0.67

3.5.3. Preference Calculation (Ranking)

Once the normalized matrix is obtained, the final preference value V_i(Impact Index) is calculated using Equation 2, which multiplies each normalized score $r_{ij}$by its criterion weight w_j, then sums across all criteria. The weights used are the same as the system configuration: C1 = 0.40, C2 = 0.25, C3 = 0.20, C4 = 0.15. This weighted aggregation is the critical step that transforms normalized data into a single ranking score that can be used operationally.

1) V1 (Flood) : (0.4 x 1.0) + (0.25 x 1.0) + (0.20 x 0.6667) + (0.15 x 0.6667)
= 0.40 + 0.25 + 0.133 + 0.1000
= 0.8833

2) V2 (Landslide) : (0.4 x 0.0213) + (0.25 x 0.02) + (0.20 x 1.0) + (0.15 x 1.00)
= 0.0085 + 0.005 + 0.20 + 0.15
= 0.3635

3) V3 (Fire) : (0.4 x 0.02) + (0.25 x 0.02) + (0.20 x 1.0) + (0.15 x 0.67)
= 0.0064 + 0.005 + 0.20 + 0.1000
= 0.3114

The manual computation produces A1 (Flood) as the top priority with an Impact Index of 0.8833, as shown in Table 5. This outcome confirms that the model behaves as intended: events with high human impact (casualties and affected families) receive stronger priority due to the largest assigned weights, while damage severity and disaster type still meaningfully influence ordering among lower-casualty events. Importantly, these manually derived Impact Index values matched those shown in the system's "Impact Index" column, thereby validating that the SAW implementation—normalization (Equation (1)) and weighted summation (Equation 2)—is mathematically consistent with the theoretical method and the system's scoring configuration.

Table 5. Final Calculation & Ranking (V_i)

Rank	Alternative	Calculation	Impact Index (V)
1	A1 (Flood)	High casualties & families affected dominate the impact index	0.8833
2	A2 (Landslide)	High damage & risk scores put it above fire.	0.3635
3	A3 (Fire)	Lower risk type score (2) vs Landslide (3).	0.3114

3.6. Prototype Evaluation

After the initial prototype was developed, an evaluation phase was conducted using Black Box Testing to ensure the system runs according to business logic and is error-free. The testing focused on input and output functionality. The project was validated using 14 distinct scenarios to ensure comprehensive system stability. Security protocols were confirmed as the system blocked unregistered logins and restricted validation page access to authorized roles only. Input validation was rigorous; the system successfully rejected incomplete entries and prevented logical errors such as negative victim counts. Core functionality tests verified that "Natural Disaster" inputs correctly triggered the SAW calculation, while "Emergency Incident" inputs correctly bypassed it, with the ranking logic accurately prioritizing heavy damage over light damage. Feature verification confirmed the successful upload of disaster photos and the generation of print-ready reports. Finally, the administrative workflow was validated through the successful execution of approval, rejection, and status filtering functions, resulting in a 100% success rate across all functional requirements.

The final stage is prototype modification, performed based on evaluation results to fix deficiencies and add necessary features for better usability. In the initial prototype, all reports were displayed in a single table and processed using the same SAW model, including minor emergency incidents such as fallen trees without victims. This introduced bias at the modeling level because the SAW method evaluated natural disasters and minor incidents using the same prioritization criteria, even though those criteria were designed to assess disaster severity. Natural disasters require comparative prioritization based on multiple impact factors, whereas minor emergency incidents follow predefined operational procedures and are not managed through severity-based ranking. Treating these events as equivalent alternatives reduced the interpretability of the SAW scores for decision support. To address this issue, the system was modified to separate reports into two distinct tables: a Natural Disaster table prioritized using the SAW method, and an Emergency Incident table sorted chronologically, ensuring clearer and more methodologically appropriate prioritization. The addition of the Incident Table can be seen In Figure 10.

The next change that was applied is to the form in the main page of head and staff, the program code was updated so that input forms change dynamically based on the selected category, the new input field can be seen in Figure 11. If the user selects "Incident," quantitative fields like "Casualties" are hidden as they are irrelevant for SAW, replaced by text description fields. Finally, the validation page for the Head of Agency was equipped

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

with interactive filters, allowing leadership to filter reports by validation status or disaster type instantly, the added filters can be seen in Figure 12.

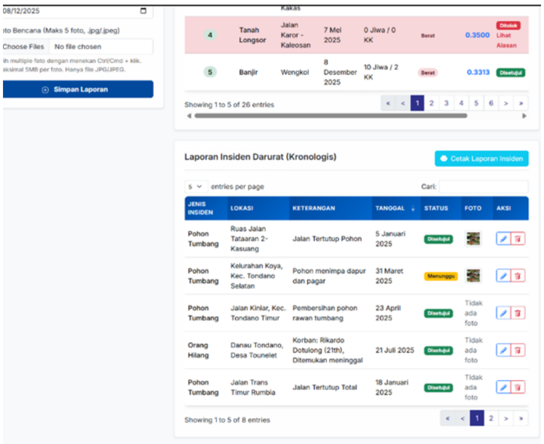

Figure 10. Incident Table Modification

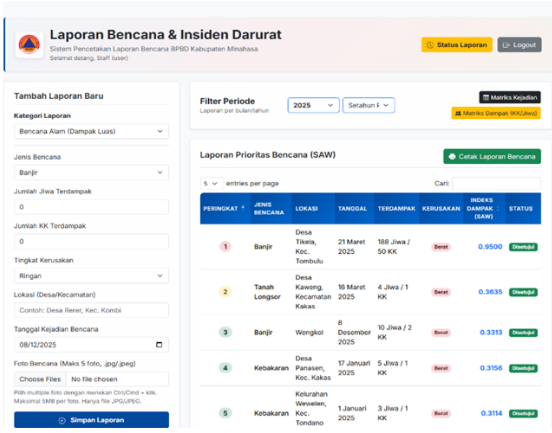

Figure 11. Form Modification for Incidents

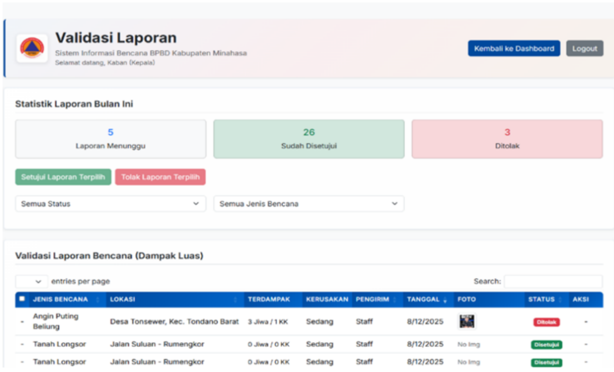

Figure 12. Validation Page Filter Addition

3.7. Discussion

The primary benefit of integrating the Simple Additive Weighting (SAW) method into the disaster reporting workflow is the transformation of static administrative data into a dynamic decision-support instrument. By converting descriptive reports into a quantifiable Impact Index, the system resolves the operational ambiguity inherent in BPBD Minahasa's previous manual workflows. This shift provides the agency with an objective mechanism to justify resource allocation, ensuring that mitigation priorities are driven by standardized metrics rather than subjective staff intuition or narrative persuasion.

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

Unlike earlier digital implementations in regional disaster agencies that focus primarily on data archiving and visualization [24], this system introduces an analytical layer that actively assists in severity assessment. The inclusion of Multi-Criteria Decision Making (MCDM) capability offers a significant advantage in prioritization accuracy, allowing management to rapidly identify critical events amidst large volumes of incoming reports. Recent studies confirm that moving beyond simple aggregate statistics to multi-criteria analysis is essential for enhancing the responsiveness and precision of emergency management systems [25], [26]. This analytical depth ensures that the system supports not just administrative efficiency, but strategic managerial effectiveness.

A unique contribution of this research is the application of ranking logic to the disaster events themselves, rather than the conventional use of SAW for beneficiary selection or logistics distribution. This approach benefits the organization by creating a macro-level view of regional vulnerability, enabling decision-makers to distinguish between high-frequency nuisances and genuine crises. This aligns with emerging trends in disaster management research where weighted criteria are used to solve complex prioritization problems, ensuring that decision outcomes are transparent and defensible [25], [26].

The operational benefit of the system is further reinforced by its adherence to legal safety standards. By mathematically weighting casualties and affected families higher than physical damage, the system guarantees that the prioritization logic remains compliant with Law of the Republic of Indonesia Number 24 of 2007 on Disaster Management. This automated compliance reduces the risk of human negligence, ensuring that life-threatening events are never overshadowed by events that are merely financially costly. This feature provides the Head of Agency with a safeguard against decision bias, ensuring that humanitarian principles are consistently applied across all disaster evaluations.

The design decision to separate "Natural Disasters" from "Emergency Incidents" ensures that the analytical precision of the system matches the operational reality of the agency. While the SAW algorithm can mathematically process all event types and sort them correctly, applying complex multi-criteria weighting to routine incidents (such as fallen trees) creates a false equivalence between procedural tasks and strategic crises. By limiting the Impact Index calculation to "Natural Disasters," the system aligns with the

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

distinct workflows required for each category: routine incidents are addressed through standard operating procedures, whereas ranked disasters trigger strategic mitigation protocols. This separation prevents the misuse of decision-support logic for events that do not require complex evaluation, ensuring the tool remains methodologically sound.

From a methodological standpoint, the use of the Prototyping approach directly benefits the long-term sustainability of the system. The iterative refinement process, specifically the adaptation of input forms to exclude irrelevant metrics for minor incidents, has mitigated the risk of user rejection often seen in public sector digital transformations. As noted in recent literature on digital adoption, aligning system logic with the tacit knowledge of field staff is a prerequisite for successful implementation [27]. The transparency of the SAW calculation offers a governance benefit; because the system's logic is linear and verifiable, it provides an auditable trail for decision-making, which is crucial for maintaining public trust and government accountability.

4. CONCLUSION

This study successfully achieved its objective by developing a web-based disaster report recapitulation system integrated with the Simple Additive Weighting (SAW) method, which effectively resolves the limitations of manual reporting at BPBD Minahasa. The implementation results confirm that the system transforms subjective narrative data into a quantifiable Impact Index, ensuring that disaster prioritization is mathematically driven by life-safety criteria in compliance with legal standards. This transition from intuitive to algorithmic decision-making provides the agency with a verifiable and objective framework for evaluating disaster severity.

The rigorous prototyping process proved critical to the system's operational viability. By structurally differentiating between routine incidents and major disasters, the design aligned the analytical logic with the tacit knowledge of field staff, thereby securing high user acceptance and reducing the risk of digital rejection. The reliability of this approach was confirmed through validation testing, where the system achieved a 100% functional success rate, ensuring that the generated rankings are both accurate and operationally dependable for official decision-making.

To further enhance this decision-support capability, future research should consider integrating Geographic Information Systems (GIS) to visualize the "Impact Index" on a real-time spatial map, allowing for cluster analysis of disaster-prone zones. Additionally, incorporating alternative decision support methods, such as the Analytic Hierarchy Process (AHP) or TOPSIS, would allow for a comparative analysis of ranking accuracy, providing deeper validation of the prioritization logic across different disaster scenarios.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the Regional Disaster Management Agency (BPBD) of Minahasa Regency for providing access to disaster-related data used in this study. Appreciation is also extended to academic mentors for their constructive guidance and support throughout the research process. The authors gratefully acknowledge all parties who contributed, directly or indirectly, to the completion of this research.

REFERENCES

[1] E. N. F. Pujiady, A. D. Prasetia, and A. Andria, "Design and Development of a Web-Based Digital Archive Information System for the Civil Registry of Magetan Regency Using the Waterfall Method (Rancang Bangun Sistem Informasi Arsip Digital Catatan Sipil Kabupaten Magetan Berbasis Website Menggunakan Metode Waterfall)," *Hello World J. Ilmu Komput.*, vol. 4, no. 1, pp. 25–48, Apr. 2025, doi: 10.56211/helloworld.v4i1.705.

[2] Meiryani, P. Siagian, R. A. A. W. Puspokusumo, and Lusianah, "Decision Making and Management Information Systems," *J. Crit. Rev.*, vol. 7, no. 7, pp. 320–325, Apr. 2020, doi: 10.31838/jcr.07.07.52.

[3] Moh. R. Nakoe and N. A. S. Lalu, *Disaster Management (Manajemen Bencana)*, 1st ed. Tulungagung, Indonesia: UD Duta Sablon, 2022.

[4] D. Lase and T. S. Alasi, "Web Implementation for Village Office Employee Data Processing Using PHP Programming Language and UML (Penerapan Web untuk Pengolahan Data Pegawai Kantor Desa Menggunakan Bahasa Pemrograman PHP dan UML)," *J. Mahajana Inf.*, vol. 9, no. 1, pp. 1–6, Jun. 2024, doi: 10.51544/jurnalmi.v9i1.5052.

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

[5] D. L. Sorongan, Q. C. Kainde, and S. C. Kumajas, "Web-Based Decision Support System for Determining the Best Employee Using the Simple Additive Weighting Method (Sistem Pendukung Keputusan Berbasis Web untuk Penentuan Karyawan Terbaik Menggunakan Metode Simple Additive Weighting)," *Indones. J. Innov. Stud.*, vol. 26, no. 4, pp. 1–35, Oct. 2025.

[6] A. M. P. Nugraha and I. H. Mursyidin, "Decision Support System for Teacher Performance Evaluation Using the SAW Method (Sistem Pendukung Keputusan Penilaian Kinerja Guru Menggunakan Metode SAW)," *bit-Tech*, vol. 7, no. 1, pp. 174–183, Aug. 2024, doi: 10.32877/bt.v7i1.1608.

[7] R. F. Nanda *et al.*, "Decision Support System by Using Multiple Attribute Decision Making with Simple Additive Weighting (MADM-SAW) Method in Selecting the Best Bromelain," *Andalasian Int. J. Agric. Nat. Sci.*, vol. 3, no. 2, pp. 114–119, Sep. 2022, doi: 10.25077/aijans.v3.i02.114-119.2022.

[8] B. S. Sinaga and F. Riandari, "Implementation of Decision Support System for Determination of Employee Contract Extension Using SAW Method," *J. Comput. Netw. Archit. High Perform. Comput.*, vol. 2, no. 2, pp. 183–186, Jun. 2020, doi: 10.47709/cnapc.v2i2.397.

[9] D. Hermansyah and F. P. Sihotang, "Decision Support System for Selecting the Best Marketing Staff Using the SAW Method (Sistem Pendukung Keputusan Penentuan Staf Marketing Terbaik Menggunakan Metode SAW)," *J. Teknol. Sist. Inf.*, vol. 3, no. 2, pp. 303–312, Sep. 2022, doi: 10.35957/jtsi.v3i2.3039.

[10] F. P. Hutagaol, M. Mesran, and J. H. Lubis, "Application of the Simple Additive Weighting (SAW) Method in Selecting Used Smartphones (Penerapan Metode Simple Additive Weighting (SAW) dalam Pemilihan Handphone Bekas)," *Bull. Inf. Technol.*, vol. 2, no. 2, pp. 63–68, Jul. 2021.

[11] K. Karsim *et al.*, "Application of Analytic Hierarchy Process and Simple Additive Weighting in Designing the Best Employee Selection Decision Support System at PT Pos Indonesia," *J. Inf. Technol.*, vol. 5, no. 4, pp. 279–284, Jan. 2024, doi: 10.60083/jidt.v5i4.453.

[12] B. Deta and S. M. I. Bedanaen, "Comparison of SAW, AHP, and TOPSIS Methods in a Decision Support System for Teacher Performance Evaluation," *Res. Horiz.*, vol. 5, no. 5, pp. 1995–2008, Oct. 2025, doi: 10.54518/rh.5.5.2025.798.

ISI Journal of Information Systems and Informatics
Published By Asosiasi Doktor Sistem Informasi Indonesia

[13] I. G. A. U. Giri and H. P. M. Dewa, "Implementation of the Simple Additive Weighting (SAW) Method in a Decision Support System for Tourist Destination Selection in North Bali," *J. Sist. Inf. Komput. Terap. Indones.*, vol. 6, no. 1, pp. 450–459, Sep. 2023.

[14] V. A. P. Salomon and L. F. A. M. Gomes, "Consistency Improvement in the Analytic Hierarchy Process," *Mathematics*, vol. 12, no. 6, p. 828, Mar. 2024, doi: 10.3390/math12060828.

[15] C. Park *et al.*, "TOPSIS and AHP-Based Multi-Criteria Decision-Making Approach for Evaluating Redevelopment in Old Residential Projects," *Sustainability*, vol. 17, no. 15, p. 7072, Aug. 2025, doi: 10.3390/su17157072.

[16] M. R. Maskur A and G. Triyono, "Decision Support System for Post-Earthquake House Renovation Aid Recipients in Cianjur Using MADM with SAW Method (Sistem Pendukung Keputusan Penerima Bantuan Renovasi Rumah Pasca Gempa Cianjur Menggunakan Multi Attribute Decision Making dengan Metode SAW)," *Faktor Exacta*, vol. 17, no. 2, p. 199, Jul. 2024, doi: 10.30998/faktorexacta.v17i2.22760.

[17] A. Fauzia *et al.*, "Analysis of Flood Disaster Evacuation Site Determination Using GIS and SAW Method (Case Study: Cileungsi District) (Analisis Penentuan Lokasi Evakuasi Bencana Banjir dengan Sistem Informasi Geografis dan Metode Simple Additive Weighting (Studi Kasus Kecamatan Cileungsi))," *J. Pendidik. Geogr. Undiksha*, vol. 9, no. 2, pp. 121–132, Aug. 2021.

[18] A. Susanto, N. W. P. Septiani, and M. Lestari, "Design of an Information System for Managing Incoming and Outgoing Letters and Official Travel Documents at Jatijajar Subdistrict (Perancangan Sistem Informasi Pengelolaan Surat Masuk Surat Keluar dan SPPD di Kelurahan Jatijajar)," *J. Ris. Apl. Mhs. Inform.*, vol. 2, no. 1, Jan. 2021, doi: 10.30998/jrami.v2i01.590.

[19] I. Faizan *et al.*, "Design and Development of a Meeting Minutes Information System Using the Prototype Method (Rancang Bangun Sistem Informasi Notulensi Rapat Menggunakan Metode Prototype)," *SemanTIK: Tek. Inf.*, vol. 9, no. 2, p. 83, Dec. 2023, doi: 10.55679/semantik.v9i2.44149.

[20] B. S. Pilando, S. C. Kumajas, and V. P. Rantung, "Web-Based Incoming and Outgoing Mail Archiving Application for the Informatics Engineering Study Program Using the Prototype Method (Aplikasi Pengarsipan Surat Masuk dan Keluar Program Studi Teknik Informatika Berbasis Web Menggunakan Metode Prototipe)," *J. Inform. Bus. Educ. Innov. Technol.*, vol. 2, no. 2, pp. 70–81, 2024.

[21] N. Dobrovolskienė and A. Pozniak, "Simple Additive Weighting versus Technique for Order Preference by Similarity to an Ideal Solution: Which Method Is Better Suited for Assessing the Sustainability of a Real Estate Project," *Entrep. Sustain. Issues*, vol. 8, no. 4, pp. 180–196, Jun. 2021, doi: 10.9770/jesi.2021.8.4(10).

[22] R. Purba, "Decision Support System for Determining Homeroom Teachers in Musda Perbaungan Private Vocational Schools Using the Simple Additive Weighting Method," *Int. J. Basic Appl. Sci.*, vol. 8, no. 3, pp. 89–96, Dec. 2019, doi: 10.35335/ijobas.v8i3.43.

[23] A. Kurniawan and R. R. Santika, "Selection of the Best Employee Using the Simple Additive Weighting (SAW) Method in a Gold Investment Company (Pemilihan Karyawan Terbaik Menggunakan Metode Simple Additive Weighting (SAW) pada Perusahaan Investasi Emas)," *J. Inform. Univ. Pamulang*, vol. 5, no. 2, p. 167, Jun. 2020, doi: 10.32493/informatika.v5i2.5265.

[24] V. D. S. Rimindubby, I. Satyarno, and A. Saputra, "Development of Information Systems in the Jayapura Regency Regional Disaster Management Agency," *J. Ilm. Multidisiplin Indones.*, vol. 2, no. 2, pp. 62–69, Jul. 2023, doi: 10.58471/esaprom.v2i02.2423.

[25] T. Li, J. Sun, and L. Fei, "Application of Multiple-Criteria Decision-Making Technology in Emergency Decision-Making: Uncertainty, Heterogeneity, Dynamicity, and Interaction," *Mathematics*, vol. 13, no. 5, p. 731, Feb. 2025, doi: 10.3390/math13050731.

[26] M. Arifiin, S. Winarno, and S. Kusumadewi, "Evaluation and Ranking of Urban Drainage Systems Using SAW, TOPSIS, and VIKOR Methods: A Case Study in Bantul Regency," *Appl. Res. Sci. Technol.*, vol. 5, no. 2, pp. 176–187, 2025.

[27] C. Feldacker *et al.*, "A Community-Based, Mobile Electronic Medical Record System App for High-Quality, Integrated Antiretroviral Therapy in Lilongwe, Malawi: Design Process and Pilot Implementation," *JMIR Form. Res.*, vol. 7, pp. 1–14, May 2023.