

Web-Based Disaster Relief Inventory Management Information System: Development and User-Acceptance Evaluation at BPBD South Sorong Regency

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Abstract

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Goods data management at the Regional Disaster Management Agency (Badan Penanggulangan Bencana Daerah, BPBD) of South Sorong Regency is still done manually with Microsoft Word and Microsoft Excel, which, according to the staff, makes the recording, searching, and reporting of relief logistics slow, prone to duplication, and exposed to data loss. This study designs, builds, and evaluates SIDATA BARANG, a web-based disaster relief inventory management information system for a regency-level BPBD. The system was developed with the Waterfall model using PHP/JavaScript, MySQL, and an AdminLTE interface. Functional conformity was verified with Black Box Testing of the main functions (login, goods data, incoming goods, and outgoing goods), and perceived feasibility (user acceptance) was measured with a seven-item questionnaire on a four-point Likert scale (1–4) answered by 30 BPBD staff. All six functional test cases passed. The overall user-acceptance score was 90.83% of the maximum possible score (a mean of 3.63 on the four-point scale), which falls into the “Very Feasible” category; all responses were in the two highest answer options (3 and 4). However, the questionnaire proved psychometrically unsound (Cronbach’s $\alpha = -6.41$, with all item-total correlations negative), so the instrument is neither valid nor reliable and this score is indicative only. The results indicate functional conformity in a single agency. They do not show improved operational efficiency or disaster-response performance, because no baseline or time measurements were taken and security and performance were not tested.

Keywords: *Information System, Disaster Logistics, Inventory Management, BPBD, Waterfall, Black Box Testing, User Acceptance*

1. INTRODUCTION

The Regional Disaster Management Agency (*Badan Penanggulangan Bencana Daerah*, BPBD) is a local government institution responsible for disaster mitigation, preparedness, emergency response, and post-disaster rehabilitation and reconstruction. In carrying out these functions, the availability of accurate and easily accessible data on disaster equipment and logistics is one of the determinants of the speed and accuracy of the response to a disaster [1]. Logistics absorbs a major share of the effort in disaster relief, and knowing what is in stock, in what condition, and where it has gone is a precondition for coordinated response [2], [3]. Orderly inventory management is also part of the accountability of state asset management [4], and a well-designed information system can help organizations manage resources more effectively and support data-driven decision making [5].

At the BPBD office of South Sorong Regency, the recording of disaster equipment and logistics is still carried out manually using Microsoft Word and Microsoft Excel. According to the staff who were interviewed, this working pattern makes the recording of incoming and outgoing goods and the preparation of monthly reports slow, prone to data duplication, and at risk of archive loss because of limited storage mechanisms [6]. A web-based inventory information system is a viable response, because it allows data to be managed in one centralized database that authorized users can reach at any time, with advantages in flexibility and ease of maintenance [7].

Inventory management aims to ensure that the right items are available in the right condition, quantity, and place at the right time [5], [7]. In humanitarian supply chains this aim is tied to several recurring concerns: stock visibility and inventory planning [8], traceability of items and transactions [9], transparency and accountability toward donors and the public [10], [11], and the information that must be shared among the parties involved in disaster logistics [12]. Recent studies associate information technology with better transparency, coordination, and traceability in humanitarian logistics [9], [10], [11]. These concerns frame the functions and the evaluation of the system reported here.

Several studies have developed inventory and logistics information systems. In general inventory settings, Susandi and Sukisno [13] built a web-based inventory system for a midwifery academy, Huda and Amalia [14] applied the Waterfall method to an inventory system at a state electricity company and reported improved report accuracy, and similar web-based systems were reported by Al Amin and Devitra [15], Usnaini et al. [16], and Guryadi and Rohmah [17]. Closer to this study, information systems for disaster logistics at BPBD institutions have been developed in other regions (Table 1): Arvita and Meisak [18] used the Prototype method for logistics needs at the Jambi Province BPBD, Rinawati et al. [19] addressed relief-logistics distribution at the Magelang Regency BPBD, and Pamiliawati et al. [20] covered logistics and equipment management at the Wonogiri Regency BPBD, including inventory, incoming and outgoing goods, borrowing, expiry monitoring, and allocation of logistics.

Table 1. *Related BPBD logistics information systems and the system in this study*

Study	Setting	Main scope
[18]	BPBD Jambi Province; Prototype method	Logistics-needs data collection, monitoring, and distribution of logistics between regions
[19]	BPBD Magelang Regency, Central Java	Relief-logistics information: matching aid to needs across locations, faster calculation of required commodities, synchronized aid records
[20]	BPBD Wonogiri Regency, Central Java	Logistics and equipment management: inventory, incoming and outgoing goods, borrowing, expiry monitoring, allocation
This study	BPBD South Sorong Regency, Southwest Papua; Waterfall	Goods inventory with condition, issue/loan linked to return, role-based access for three roles, monthly report; evaluated by Black Box Testing and questionnaire (n = 30)

These studies show that information systems for BPBD logistics are feasible and useful, so the contribution of this article is not a new technique. What the existing work leaves open for the present case is empirical and contextual. First, a regency-level BPBD in Southwest Papua works under conditions that differ from those of the agencies in Table 1: limited IT resources and, according to the interviews, records kept in Word and Excel files. Whether a deliberately minimal system is workable and accepted under these conditions has, to the authors' knowledge, not been

reported for this region. Second, SIDATA BARANG is narrower than the system in [20]: it omits expiry monitoring and allocation planning and concentrates on recording items with their condition, linking each issue or loan to its return, controlling access by role, and producing a monthly report. Third, functional testing alone says little about acceptance, and acceptance ratings alone say little about function, so both are reported here with an explicit statement of what each can and cannot show.

The claims of this article are limited accordingly. Five constructs are easily confused in studies of this kind: system capability (what the system can do), perceived usefulness, user acceptance, measured operational efficiency (for example, time per transaction or error rates), and actual improvement in disaster-response performance. This study addresses the first three: capability through functional testing, and perceived usefulness and acceptance through a questionnaire. It does not measure operational efficiency or response performance, and statements about faster or more efficient work are therefore treated as expectations, not findings.

The article makes three contributions. (1) It documents the requirements and workflow of a regency-level BPBD in Southwest Papua and shows how they were translated into a design (use case, activity, sequence, class, and entity relationship models, and a data dictionary) that links each issued item to its return and to periodic reports. (2) It gives a reproducible account of the evaluation: itemized functional test cases, an itemized questionnaire, and an explicit scoring procedure, together with a statement of the validity limits of each. (3) It reports the outcome of a two-level evaluation for an under-resourced regional agency, together with an explicit statement of how far ratings from a single site, concentrated in the two highest answer options, support a claim of acceptance.

This study is guided by two research questions: (RQ1) how can the goods data management process of a regency-level BPBD be designed and implemented as a web-based system using the Waterfall model, and (RQ2) to what extent does the resulting system conform to its functional requirements, and how do its users rate it on usability, functionality, efficiency, data accuracy, and overall satisfaction? The remainder of this article is

organized as follows. Section 2 describes the research methodology, Section 3 presents and discusses the results, and Section 4 concludes the study.

2. METHODS

2.1 Research design and object

This study is a design and development in software engineering, a limited form of Research and Development (R&D) [21], carried out as a single-site case study. R&D was chosen because the main output is an information system product that the institution uses directly, and the study covers needs analysis, product design, product development, validation by testing, and a limited user evaluation. The later steps of a full R&D cycle, such as product revision after field trials, wide dissemination, and mass production, were outside the scope. The study should therefore be read as a software-engineering case study of one agency and not as a controlled experiment. The object of the research is the goods data management process at the BPBD office of South Sorong Regency, covering the recording of incoming goods, outgoing goods, goods condition, and monthly reporting, all of which were previously done manually. The questionnaire was administered before the Black Box Testing because it was intended to capture users' perceptions after a limited field trial, in which respondents used the main functions of the implemented system in their routine work for five days. This corresponds to the user trial stage commonly included in research and development approaches [21]. Functional verification against the requirement specification was carried out afterwards as a structured test (see Functional testing). The two instruments measure different constructs: perceived usability and usefulness, and functional suitability, respectively [24]; the result of one therefore does not depend on the other.

2.2 Data collection and requirements elicitation

Data were obtained through interviews, observation, and documentation of the existing goods management workflow at the BPBD office, supplemented by a literature study of software engineering references and similar studies. Interviews were held with 8 informants

(one head or coordinator of the relevant division, two logistics staff, two administrative staff, two field officers, and one data manager/operator), selected purposively because they are directly involved in recording, issuing, or reporting goods, using a semi-structured guide on the current recording steps, the problems experienced, the report formats, and the users and their rights. Observation of the recording, storage, searching, and issuing of relief goods at the BPBD office lasted (15–20 September 2024), and the interviews were held between 15 and 20 September 2024. Of the 8 informants, 5 were male and 3 were female; by age, 2 were 20–30 years old, 3 were 31–40, 2 were 41–50, and 1 was over 50. The documents analyzed were the existing Word and Excel files and monthly reports.

The interview, observation, and document data were processed into a list of functional and non-functional requirements. The requirements were subsequently reviewed with relevant stakeholders to ensure their suitability and relevance to the needs of the users before the design process began.

2.3 System development model

The system was developed using the Waterfall SDLC model [23], chosen because the requirements at the early stage of the research were relatively clear and stable. Stability was judged from three conditions: the scope is a single recording-and-reporting workflow that follows established BPBD logistics guidance [1]; the requirement list was reviewed with the institution before design; and no significant changes were identified during the transition from requirements analysis to implementation. The usual weakness of Waterfall, that usability problems may surface only after implementation, is taken up in the discussion of the questionnaire results. The stages consist of (1) requirements analysis, (2) system design, (3) implementation, (4) testing, and (5) maintenance, as shown in Figure 1.

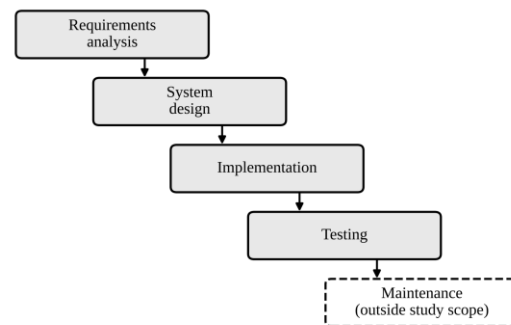


Figure 1. Waterfall model stages used in this study (redrawn after [23]).

In the requirements analysis stage, system needs were identified from the problems of the running manual recording process. The design stage translated these needs into Unified Modeling Language (UML) models and a database design. The implementation stage is the writing of the program based on the design results, and the testing stage checks that the functions work as intended. The maintenance stage (corrections and adaptation after deployment) is outside the scope of this article: no maintenance activity is reported here.

2.4 Research instrument and respondents

The user acceptance instrument was a closed questionnaire of seven statements grouped into five dimensions: usability (2 items), functionality (2 items), efficiency (1 item), data accuracy (1 item), and overall satisfaction (1 item). The statements and their dimensions are listed in Table 2. The instrument was developed based on the study objectives and the characteristics of the system being evaluated. The dimensions relate to interaction capability (called usability in the 2011 edition) and functional suitability in ISO/IEC 25010 [24], together with perceived usefulness. These dimensions were selected as the basis for assessing users' perceptions of the system; they describe users' perceptions and are not measurements of the corresponding technical qualities. Three dimensions (efficiency, data accuracy, and overall satisfaction) have a single item each, so they are reported at item level only. Each statement was answered on a four-point Likert scale scored 1 (Strongly Disagree), 2 (Disagree), 3 (Agree), and 4 (Strongly Agree). This four-point scale is the only scale used in the instrument, the analysis, and the results. An even number of points was used so that

respondents cannot select a neutral midpoint and must state a clear tendency.

Table 2. *Questionnaire statements*

Code	Dimension	Statement
Q1	Usability	The system is easy to use for managing disaster relief goods data.
Q2	Usability	The system makes it easy for users to enter goods data.
Q3	Functionality	The system makes it easy for users to update goods data.
Q4	Efficiency	The system makes it easy for users to search for goods and stock information.
Q5	Data accuracy	The system helps reduce errors in recording goods inventory.
Q6	Functionality	The system makes it easier to monitor incoming and outgoing goods.
Q7	Overall satisfaction	The system can improve the effectiveness of managing disaster relief goods inventory.

Content validity was checked by two experts in information systems and research methodology, who reviewed the questionnaire before it was distributed to the respondents. Item validity was tested by the correlation of each item with the total score (Pearson r compared with the critical value for $n = 30$), and reliability by Cronbach's alpha, with $\alpha \geq 0.70$ taken as acceptable [25]. The results are reported under User acceptance testing. With seven items and 30 respondents, these coefficients are indicative and must be interpreted with care.

The respondents were 30 BPBD South Sorong Regency staff members who are directly involved in goods management and therefore use, or are directly affected by, the recording, issuing, and reporting of goods. They were selected by purposive sampling, in which respondents are chosen for their direct knowledge of or involvement in relief-goods inventory management (personnel in logistics, administration, field operations, and inventory data management); the inclusion criterion was being a BPBD South Sorong Regency employee or staff member involved in goods data management, logistics, or inventory administration, or having experience using computer systems for related work. The questionnaire was distributed in person as a printed (paper-based) questionnaire after respondents had tried the main functions of the system for five days (15–20 October 2024); participation was voluntary, and respondents were informed that their responses would be used solely for research purposes; no personally identifying information was collected in the

questionnaire. The respondents' characteristics are given in Table 12. The System Usability Scale (SUS) [26], a standardized ten-item usability instrument, was not used in this study; its use is proposed for future evaluation.

2.5 Data analysis procedure

Two forms of analysis were applied. First, the Black Box Testing results were analyzed descriptively. Each test case specifies an input, an expected output derived from the requirement specification, and the actual output observed; a case is declared "Passed" only when the actual output matches the expected output [27]. Second, the questionnaire answers were tabulated per respondent and item. For each item and dimension the mean and standard deviation were computed, and the overall feasibility percentage was calculated with equation (1) [27].

$$Y = \frac{P}{Q} \times 100\% \quad (1)$$

where Y is the feasibility percentage (%), P is the total score of the respondents' answers, and Q is the maximum possible score. With 30 respondents, seven items, and a maximum of 4 points per item, $Q = 30 \times 7 \times 4 = 840$. The percentage was assigned to one of five categories (Table 3). Two properties of this scale matter for interpretation. Because the lowest answer is coded 1 and not 0, the lowest attainable percentage is 25%, so the lowest category cannot occur. And the midpoint of the four-point scale (mean 2.5) corresponds to 62.5%, so a score in the "Feasible" range that is close to 62.5% indicates an average answer close to the middle of the scale. The category labels describe score ranges and are not a formal acceptance threshold.

Table 3. *Interpretation of the feasibility score [27]*

Score range	Category
0% – 19.99%	Very Not Feasible
20% – 39.99%	Less Feasible
40% – 59.99%	Fairly Feasible
60% – 79.99%	Feasible
80% – 100%	Very Feasible

Using both analyses reflects the view that software quality has a functional dimension, verified against the specification, and a usability dimension, judged by the people who use the system [24].

3. RESULTS AND DISCUSSION

3.1 System requirements analysis

Functional testing was conducted after the user questionnaire (see Research instrument and respondents), as a structured verification of the main functions against the requirement specification. Interviews, observation, and document analysis of the goods management process at the BPBD office of South Sorong Regency produced the functional and non-functional requirements in Table 4 and Table 5. The last column of Table 4 shows the test module that covers each functional requirement.

Table 4. Functional requirements of the system

No	Requirement	Description	Tested in
1	Goods Data Management	The system manages incoming goods data, goods condition, and goods history.	Goods Data
2	Outgoing/Returned Goods Management	The system records the lending/issuing of goods and their return.	Outgoing Goods; Returned Goods
3	User Management	The system provides different access rights for Admin, Person in Charge, and Head of Division (Kabid).	Login (authentication and role access only)
4	Warehouse Report	The system generates monthly goods reports by period.	Warehouse Report

Table 5. Non-functional requirements of the system

No	Requirement	Description
1	Security	System access requires an authentication (login) process according to the user role.
2	Usability	The interface uses the AdminLTE template so that it is easy for users to learn.
3	Performance	The system can be accessed online through a web browser and shows the current database content on each request. No quantitative response-time target was specified.

3.2 System design

The system design was modeled using UML, covering use case, class, activity, and sequence diagrams [29]. In the use case diagram, the system involves three actors with different access rights, namely Admin, Person in Charge, and Head of Division (*Kepala Bidang*, Kabid), as summarized in Table 6.

Table 6. Description of actors and main use cases

Actor	Use Case	Description
Admin	Manage Goods Data	Adds, edits, and deletes goods data, condition, and history.

Actor	Use Case	Description
Admin	Manage Outgoing/Returned Goods	Records outgoing and returned goods transactions.
Person in Charge	Submit Loan Request	Submits a request to borrow goods to the admin.
Head of Division	View Report	Views and downloads the monthly goods report.

The database was designed using MySQL with the main entities being goods data, goods category/condition, outgoing goods transactions, returned goods transactions, users, and reports. These entities are related to each other to support complete tracing of goods history. The interface design uses the AdminLTE template so that it is consistent and familiar to users accustomed to dashboard-based applications.

Figure 2 shows the overall architecture of the system, which follows a three-layer web architecture. Users in the three roles access the system through a web browser (presentation layer); requests are handled by PHP scripts that implement the authentication, the role-based access control, and the four goods-related modules (application layer); and all persistent data are stored in a single MySQL database (data layer). Centralizing the data in one database replaces the separate Word and Excel files that were used before, and it is the basis for the traceability of goods history.

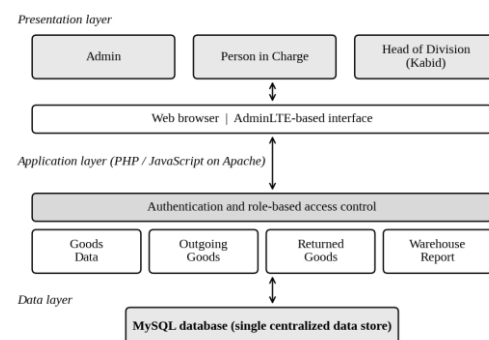


Figure 2. System architecture of SIDATA BARANG.

Table 7 summarizes the role of each main database entity. The relationships among these entities allow an item to be traced from its registration, through its issuing and return, to its appearance in the periodic report.

Table 7. Main database entities and their roles

Entity	Role in the System
Goods	Stores the identity, category, and condition of each item.
Goods category/condition	Classifies items so that stock can be filtered and reported by condition.

Entity	Role in the System
Outgoing goods	Records each transaction in which an item is lent or issued.
Returned goods	Records the return of items that were previously issued.
Users	Stores accounts and roles (Admin, Person in Charge, Head of Division) used for authentication and access rights.
Reports	Aggregates transactions by period to produce the monthly warehouse report.

Use case diagram. Figure 3 presents the use case diagram, which shows the boundary of the system and the interaction of the three actors with it. All actors must log in first, so authentication is the entry point of every use case. The Admin manages goods data and records outgoing and returned goods, the Person in Charge submits loan requests, and the Head of Division views and downloads the monthly report. Separating the use cases by actor is how the role-based access rights stated in the functional requirements are expressed in the model.

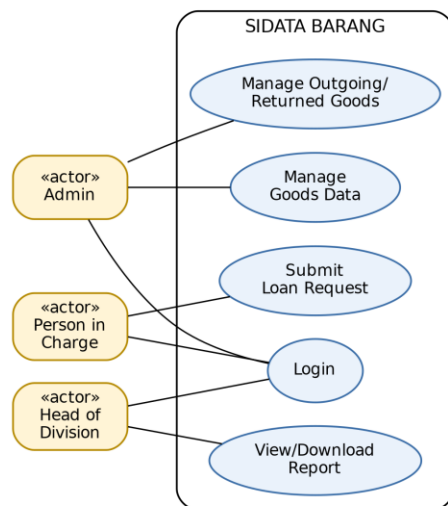


Figure 3. Use case diagram of SIDATA BARANG.

Activity diagram. The flow of a loan transaction is modeled in Figure 4. The process starts when a Person in Charge submits a loan request. The Admin checks the request against the available stock; if the stock is sufficient, the Admin records the outgoing goods and the system reduces the stock, and when the goods are returned the Admin records the return and the system updates the stock and condition. If the stock is not sufficient, the request is rejected and the process ends. Modeling this flow shows where the system replaces the manual notes that were previously kept in Word and Excel files.

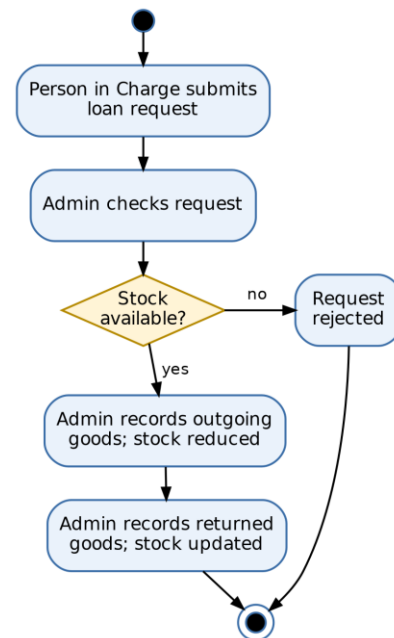


Figure 4. Activity diagram of the loan and return process.

Sequence diagram. Figure 5 describes the order of messages when the Admin records outgoing goods. The Admin fills in the form on the web interface, the form is submitted to the PHP controller, and the controller checks the stock in the MySQL database. When the stock is sufficient, the controller inserts the outgoing transaction and updates the stock in the same step, and a confirmation is displayed to the Admin. Keeping the stock check and the update in one request is intended to prevent a transaction from being saved when the stock does not support it.

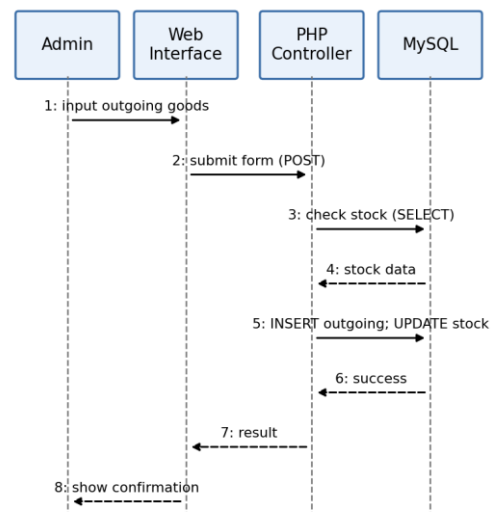


Figure 5. Sequence diagram of recording outgoing goods.

Class diagram. The static structure of the system is shown in Figure 6. The User class holds the account and role used for

authentication, the Category class classifies items, and the Goods class stores the identity, condition, and quantity of each item. The OutgoingGoods and ReturnedGoods classes represent the issuing and return transactions, while the Report class aggregates transactions by period. One category contains many goods, one item can appear in many outgoing transactions, one user can record many outgoing transactions and reports, and each outgoing transaction can be followed by returned-goods records.

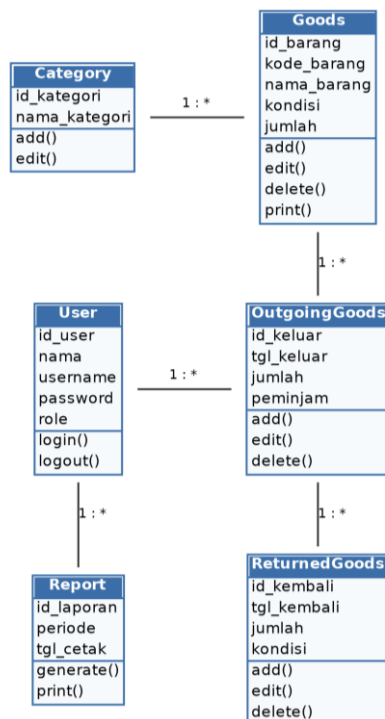


Figure 6. Class diagram of SIDATA BARANG.

Entity relationship diagram. The class model was translated into the relational database design shown in Figure 7. Each entity in Table 7 becomes a table with a primary key, and the one-to-many relationships become foreign keys: id_kategori in the goods table, id_barang and id_user in the outgoing goods table, id_keluar in the returned goods table, and id_user in the report table. Linking a return to the outgoing transaction that it closes is what allows the history of an item to be traced from registration to the monthly report, as required in the design stage.

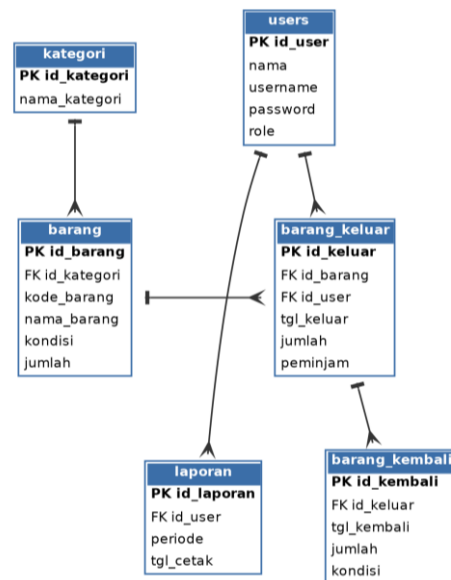


Figure 7. Entity relationship diagram (ERD) of the SIDATA BARANG database.

Table 8 lists the attributes of every table in the database. The attribute names follow the naming used in the implemented database, and the marks PK and FK identify the primary key and the foreign key of each table. A foreign key always points to the primary key of the parent table in Figure 7, so a record in a child table cannot exist without its parent record.

Table 8. Data dictionary of the main database tables

Table	Attributes	Description
users	id_user (PK), nama, username, password, role	Account and role of each user.
kategori	id_kategori (PK), nama_kategori	Classification of goods.
barang	id_barang (PK), id_kategori (FK), kode_barang, nama_barang, kondisi, jumlah	Identity, condition, and stock of each item.
barang_keluar	id_keluar (PK), id_barang (FK), id_user (FK), tgl_keluar, jumlah, peminjam	Each lending or issuing transaction.
barang_kembali	id_kembali (PK), id_keluar (FK), tgl_kembali, jumlah, kondisi	Return of issued items and their condition.
laporan	id_laporan (PK), id_user (FK), periode, tgl_cetak	Monthly warehouse report by period.

3.3 System implementation

The design results were implemented as SIDATA BARANG using the PHP and JavaScript programming languages, a MySQL database, and an AdminLTE-based interface. Table 9 summarizes the technology components used.

Table 9. System implementation specification

Component	Technology
Programming Language	PHP, JavaScript
Database	MySQL
Interface Framework	AdminLTE
Web Server	Apache (XAMPP)

Figure 8 shows the dashboard page that appears after the user successfully logs in. This page presents a summary of the number of items and a navigation menu to the item data, outgoing items, returned items, and warehouse report modules, so users can monitor the inventory condition without opening separate files as in the previous manual process.



Figure 8. Dashboard of SIDATA BARANG.

3.4 Functional testing (Black Box Testing)

Functional testing used Black Box Testing, which focuses on the conformity of system inputs and outputs to the requirement specification without examining the program code structure [26]. Six test cases were derived from the main functional requirements: login, goods data (add, edit, and search), incoming goods, and outgoing goods. Only valid, normal-flow scenarios were tested; invalid input, access control, returned goods, and the warehouse report were not covered by the test cases reported here. Testing was run by the researcher together with BPBD staff and operators in the BPBD work environment, on computers or laptops connected to the local network or the internet and using Google Chrome version 140.0.7339.186 and XAMPP 8.2.12 as the web server stack, on 06–09 November 2024. The tests used relief-goods inventory data entered into the system to exercise goods data management, searching, and incoming and outgoing goods transactions. The cases and their outcomes are listed in Table 10.

Table 10. Black Box Testing cases and results

ID	Module and scenario	Input	Expected output	Result
TC-01	Login	Valid username and password	Dashboard shown	Passed
TC-02	Goods data: add	Valid item data	Item saved to the database	Passed
TC-03	Goods data: edit	Changed item data	Item data updated	Passed
TC-04	Goods data: search	Search keyword	Items matching the keyword shown	Passed
TC-05	Incoming goods	Quantity of goods received	Stock increases by the quantity entered	Passed
TC-06	Outgoing goods	Quantity of goods issued	Stock decreases by the quantity issued	Passed

All six test cases passed (6/6, 100%). This shows conformity to the specification for the normal-flow scenarios tested only. It does not establish overall software quality: the tests do not cover invalid input, access control beyond a valid login, returned goods, the warehouse report, security weaknesses, performance under load, browser compatibility, or database integrity under concurrent use. Table 11 states which non-functional requirements were verified and how.

Table 11. Verification status of non-functional requirements and other quality aspects

Aspect	How verified	Status
Security	Login case TC-01	Partly: valid login only; no wrong-password, role-access, vulnerability, session, or password-storage testing
Usability	Questionnaire (User acceptance testing)	Perceived only; no standardized instrument or task-based test
Performance	None	Not verified; response time and load were not measured, and no claim of real-time access is made
Compatibility	None	Not tested across browsers or devices
Database integrity	Foreign-key design (Table 8)	Not tested, for example under concurrent use

3.5 User acceptance testing

User acceptance was measured with the questionnaire described under Research instrument and respondents, answered by 30 BPBD South Sorong Regency staff who are directly involved in goods management. Table 12 summarizes the respondents.

Table 12. *Characteristics of respondents (n = 30)*

Characteristic	Distribution, n (%)
Role in goods management	Logistics/inventory 10 (33.3); Administration 8 (26.7); Operational/field 7 (23.3); Data management/operator 5 (16.7)
Sex	Male 19 (63.3); Female 11 (36.7)
Age	20–30 years 7 (23.3); 31–40 years 10 (33.3); 41–50 years 9 (30.0); >50 years 4 (13.3)

Item validity: the corrected item–total correlations ranged from -0.71 to -0.55 , so no item reached the critical value $r = 0.361$ ($n = 30$, 5% level). Reliability: Cronbach's alpha was -6.41 for the seven items, far below the 0.70 criterion. A negative alpha arises here because every answer was 3 or 4 and every respondent's total was 25 or 26, leaving almost no variance between respondents; the items therefore do not covary positively. The instrument cannot be declared valid or reliable, and the feasibility score below is reported as a descriptive summary of perceptions only. Table 13 gives the item-level results and Table 14 the dimension-level and overall results. The total obtained score was $P = 763$ out of $Q = 840$, so that $Y = 763/840 \times 100\% = 90.83\%$.

Table 13. *Item-level results of the questionnaire (n = 30)*

Item	Dimension	Mean	SD	% of maximum
Q1	Usability	3.53	0.51	88.33
Q2	Usability	3.67	0.48	91.67
Q3	Functionality	3.63	0.49	90.83
Q4	Efficiency	3.67	0.48	91.67
Q5	Data accuracy	3.70	0.47	92.50
Q6	Functionality	3.53	0.51	88.33
Q7	Overall satisfaction	3.70	0.47	92.50

Table 14. *Dimension-level and overall results*

Dimension	Mean (1–4)	% of maximum	Category
Usability	3.60	90.00	Very Feasible
Functionality	3.58	89.58	Very Feasible
Efficiency	3.67	91.67	Very Feasible
Data accuracy	3.70	92.50	Very Feasible
Overall satisfaction	3.70	92.50	Very Feasible
Overall	3.63	90.83	Very Feasible

The overall score of 90.83% corresponds to a mean answer of 3.63 on the four-point scale and falls in the “Very Feasible” category of Table 3. At the dimension level, usability reached 90.00%, functionality 89.58%, efficiency 91.67%, data accuracy 92.50%, and overall satisfaction 92.50%, so the five dimensions were rated within about three

percentage points of one another; three of them consist of a single item each. At the item level, Q5 and Q7 had the highest percentage (92.50%) and Q1 and Q6 the lowest (88.33%); a range of about four percentage points is too small to read as a meaningful difference between items. All 210 responses ($30 \text{ respondents} \times 7 \text{ items}$) were either 3 or 4: no respondent selected 1 or 2, so the answers are concentrated in the two highest options and the variance is small. The score reflects perceptions after use. The questionnaire did not measure how quickly goods are recorded, searched, or reported, so it cannot show that the system speeds up goods data management.

3.6 Discussion

Black Box Testing and the questionnaire answer different questions. Black Box Testing indicates whether the system conforms to its technical specification; the questionnaire indicates how users rate it after use. Studies of Waterfall-based inventory systems [14], [16] report that functionally tested systems tend to be rated well by users, and a commonly offered explanation is that the Waterfall stages require requirements to be defined fully before implementation. The present results are consistent with those reports: functional conformity was complete for the normal-flow scenarios and acceptance was rated highly. Because both results come from the same single-site, small-sample study, they should not be read as showing that functional conformity produces acceptance. Compared with the BPBD systems in Table 1, SIDATA BARANG is narrower in scope. It has no expiry monitoring or allocation function as in [20] and does not support distribution between regions as in [18]. Its scope is simpler and can be implemented in institutions with limited IT resources such as the BPBD of South Sorong Regency, but a narrower scope may also limit the benefit that users perceive.

The user evaluation resulted in an overall feasibility score of 90.83%, which corresponds to the “Very Feasible” category according to the interpretation criteria in Table 3. This result should be distinguished from direct measures of operational performance. The questionnaire captures users’ perceptions of the developed system, not recording time, reporting time, error frequency, duplication rate, or disaster-response performance. The findings therefore indicate perceived feasibility among the participating

respondents; they do not constitute quantitative evidence that the system improves operational efficiency. Three features of the data call for caution. First, every answer was 3 or 4, so the responses are concentrated at the top of the scale; this limits the ability of the instrument to discriminate between items or respondents and suggests a possible ceiling effect. Second, the respondents are staff of the institution that adopted the system, so social desirability may have raised the ratings. Third, the differences between dimensions (about three percentage points) and between items (about four percentage points) are small, so no dimension or item is identified as a weakness. Possible explanations that were raised earlier, such as users' familiarity with Microsoft Word and Excel procedures or the absence of automated notifications, are not tested by any questionnaire item and are treated as hypotheses for future work, for example through follow-up interviews or a comparison of new and experienced users.

In terms of ISO/IEC 25010:2023 [23], the product quality model has nine characteristics. Black Box Testing mainly addresses functional suitability, with the login case touching security only in part. The questionnaire addresses interaction capability (named usability in the 2011 edition) and perceived usefulness. Performance efficiency, compatibility, reliability, security beyond access control, maintainability, flexibility (named portability in the 2011 edition), and safety were not evaluated. The 2023 edition is used because it replaces the 2011 edition; functional suitability was retained and usability was renamed. Neither technique alone covers the other's dimension, which is why both are reported, and why neither supports a claim of overall quality.

Table 15 relates the functions of SIDATA BARANG to the humanitarian logistics concerns identified in the Introduction, and shows what the system does not cover. The comparison is conceptual and rests on the design and the functional tests, not on measured outcomes. The system supports traceability and stock visibility at record level within one agency, which are the concerns most directly tied to the manual-process problems found. Coordination, information sharing beyond the agency, field distribution, and interoperability are not covered and mark the limits of the present version.

Table 15. *Humanitarian logistics concerns and their coverage in SIDATA BARANG*

Concern	Support in the system	Gap
Traceability	Each return is linked to the issue it closes (id_keluar); item history from registration to report	Record level only; no batch or serial tracking
Stock visibility	Single database; dashboard summary of item counts	One site; no stock per location
Accountability	User ID stored with outgoing records and reports; role-based access	No audit trail of edits or deletions described
Information sharing and coordination	Head of Division can view and download the monthly report	Internal to the BPBD; no sharing with other agencies
Warehouse management	Category, condition, and quantity per item	No expiry dates, storage locations, or reorder rules
Emergency response and distribution	Internal loan request and issue/return recording	No field or mobile access (Android planned); no notification
Data interoperability	Report view, download, and print	No standard exchange format or integration with other systems

3.7 Comparison with the manual process

Table 16 compares the manual process with SIDATA BARANG on the aspects identified in the requirements analysis. The last column states the basis for each statement. The comparison is qualitative: no time, error-rate, duplication-rate, or data-loss measurements were taken before or after deployment, so statements about faster searching or reduced risk describe design intent and not measured effects.

Table 16. *Manual process versus SIDATA BARANG*

Aspect	Manual (Word/Excel)	SIDATA BARANG	Basis
Data storage	Separate files kept by individual staff	Single centralized MySQL database	Design
Recording	Manual entry in documents; prone to duplication (staff report)	Form-based input through dedicated modules	Design; TC-02 to TC-06
Searching	Opening and scanning several files	Menu-based access to goods data from the dashboard	Design; not timed
Reporting	Prepared manually each month	Generated by period from stored transactions	Design; not tested
Access rights	No separation by user role	Login with role-based rights (Admin, Person in Charge, Head of Division)	TC-01 (login); role rights by design only

Aspect	Manual (Word/Excel)	SIDATA BARANG	Basis
Data safety	Archives at risk of being lost	Data kept in one database; backup procedure not evaluated	Design; not tested

These differences correspond to the three problems identified in the Introduction: slow recording and reporting, data duplication, and archive loss [6]. Whether the system reduces them in practice remains to be shown by measurement.

3.8 Practical implications

For BPBD South Sorong Regency, the system is intended to provide a single source of information on disaster logistics stock, which can support quicker answers to requests for equipment and more accountable reporting of state assets [4]; whether it does so in practice has not been measured. Disaster management in Indonesia is regulated by Law No. 24 of 2007 [30] and Government Regulation No. 21 of 2008 [30], which place responsibility for implementing disaster management, including logistics support, on central and regional governments. A reliable goods information system can help regional agencies carry out this responsibility in a documented way. Because SIDATA BARANG relies on widely available open technologies (PHP, MySQL, and Apache), it can run on modest hardware and could be replicated at other regency/city BPBDs with limited IT budgets. Its value will depend on conditions that this study did not examine, such as training, discipline in entering data, regular backups, and the notification and mobile access that users may expect.

3.9 Limitations and threats to validity

Several limitations apply. (1) Design: the study is a single-site case study with 30 respondents, which limits external validity; there was no control group and no baseline measurement of recording, searching, or reporting time, so the improvement over the manual process is perceived and not quantified. (2) Instrument: the questionnaire has seven items, uses a four-point scale, and is not a standardized instrument such as SUS; its validity and reliability are not supported (corrected item–total correlations were negative and Cronbach's alpha was -6.41); and all responses fell in the two highest answer options (3 and 4), which indicates restricted variance

and a possible ceiling effect; with a four-point scale the lowest attainable score is 25%, and the Riduwan categories, which assume a zero origin, should be read with this in mind. (3) Testing: Black Box Testing verifies behavior against the specification and cannot reveal defects in the internal code; security, performance and load, browser compatibility, and database integrity were not tested, although security and performance are stated as non-functional requirements, and no quantitative claim is made about response time. Sequence of evaluation: the questionnaire (15–20 October 2024) preceded Black Box Testing (06–09 November 2024) because it was intended to capture perceptions after a five-day field trial of the system in the work environment, with Black Box Testing following as structured verification. This departs from the usual practice, so respondents rated the system before its functions were formally verified. Future studies should conduct functional testing first. (4) Bias: the respondents are staff of the institution that adopted the system, so social desirability bias may have raised the ratings. (5) Scope: the maintenance phase was not evaluated. Future studies should combine a standardized usability instrument, security and load testing, and a before-and-after measurement of recording, search, and reporting time.

CONCLUSION

This produced SIDATA BARANG, a web-based disaster relief inventory management information system developed with the Waterfall SDLC model for the BPBD office of South Sorong Regency. Black Box Testing of the main functions (login, goods data, incoming goods, and outgoing goods) showed conformity to the specified functional requirements in the test cases executed, and a questionnaire answered by 30 staff gave an overall user-acceptance score of 90.83% on a four-point scale, in the “Very Feasible” category, with every answer in the two highest response options. The evidence therefore supports three statements: the system works as specified in the scenarios tested; its users in a single agency perceive it as highly feasible; and it can serve as a reference implementation of a web-based inventory system for a regency-level BPBD. It does not demonstrate that the system can replace the manual recording process in all

respects, nor that it improves response time, reduces inventory errors or duplication, speeds up reporting, or improves disaster-response performance, because none of these was measured. The main limitations are the single site, the small and non-standardized questionnaire, and the absence of security, performance, and quantitative before-and-after testing.

Further work is suggested in five directions: (1) security, performance and load, and compatibility testing; (2) a standardized usability measure such as SUS [27] alongside the questionnaire; (3) a quantitative comparison with the manual process, measuring the time to record, search, and report, and error and duplication rates; (4) an Android-based version for field officers and notification through WhatsApp or a Telegram bot to give early warning of critical stock; and (5) testing at other regency/city BPBDs to assess the generalizability of the results.

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Data Availability: The questionnaire results are summarized in Tables 12–14. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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