

Web-based project material inventory information system at PT XYZ using the waterfall method

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ABSTRACT

PT XYZ is an enterprise operating in the building contractor sector with a high intensity of material movement. Currently, the warehouse inventory management procedure in the company still relies on conventional methods using a manual physical Logbook. This mechanism triggers various operational obstacles, such as a high risk of handwriting errors (human error), stock discrepancies between physical availability and written balances, and a slow cascade of report recapitulation for management. This study aims to design and develop a Web-Based Project Material Inventory System to digitalize the entire workflow of stock management. The system development method implemented is the Waterfall model, which encompasses requirement analysis, design, implementation, testing, deployment, and maintenance. This computerized application is built using the PHP programming language with the Laravel framework, a MySQL database, and supported by a Tailwind CSS-based interface. System functionality testing was conducted through the Black Box Testing method to ensure all operational modules run according to the system requirements. The final result of this research is a centralized information system capable of managing master data (items, vendors, units, projects), processing incoming and outgoing item transactions with automatic stock calculation, and presenting inventory mutation reports in real-time. The implementation of this system has been proven to reduce warehouse administrative burdens, eliminate the risk of physical damage to paper documentation, and accelerate managerial decision-making processes at PT XYZ.

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1. INTRODUCTION

In the modern construction industry ecosystem, which demands high efficiency, material supply chain management plays a very vital role in ensuring operational continuity in project areas. Building material logistics require strict inventory control mechanisms to prevent disruptions to the construction timeline. Managing construction materials requires integrated information systems to ensure field demands are met efficiently without increasing operational costs (Syarif Maulana & Mulyanto, 2025). However, the fluctuating activities of incoming and outgoing operational goods often become a major obstacle to the organization's internal governance when they are not supported by an integrated recording system. This condition triggers various daily operational difficulties, particularly in the accuracy of physical asset tracking and delays in the preparation of reporting documentation (Elisabet Br Aritonang et al., 2025). This phenomenon of logistical uncertainty is exacerbated by the organization's dependence on conventional work patterns that

neglect dynamic information updates, thereby creating internal inconsistencies between administrative records and actual needs in construction areas (Hidayat & Satria Putra, 2025).

This condition has become a real challenge for PT XYZ, which actively operates in the building construction contractor sector. Based on observational analysis conducted at the research object, the procedure for recording the movement of crucial materials such as cement and various types of steel still applies conventional methods using a single physical medium at the field post, namely the Warehouse Logbook. This handwritten recording method is highly vulnerable to physical document damage. The open construction project environment, characterized by heavy dust, humidity, and high exposure to extreme weather conditions, makes the Warehouse Logbook highly susceptible to physical damage, such as tearing, deterioration, or destruction due to spills of liquid cement materials (Chafid et al., 2025). Another weakness of using daily paper-based records is the high risk of data loss caused by damage to or loss of physical documents. If the Warehouse Logbook is physically damaged or lost before the data are transferred, the entire history of the company's logistics inventory movements will be permanently lost, making inventory monitoring inefficient (Pamungkas et al., 2025). The absence of archive protection mechanisms places the company in a vulnerable position regarding the loss of valuable operational asset records (Musari Azani & Marwati, 2025).

Data inconsistency is also a detrimental consequence resulting from warehouse activities that rely on conventional handwritten records. Physical fatigue experienced by field officers frequently causes errors in recording inventory movement records, mistakes in calculating running balances, and increases the risk of losing sheets of logistics documents within the project area (Fathoni & Kustiyono, 2025). As a result, the company often faces inventory discrepancies, where the actual quantity of materials physically available in the field is significantly lower than the recorded balance (Setyadi & Nurajijah, 2024). These inaccuracies in daily data entry subsequently accumulate within administrative management processes at the head office. Warehouse personnel must manually inspect and match the physical condition of materials one by one with records in the Warehouse Logbook for daily stock opname preparation, a procedure considered ineffective and responsible for significant time wastage due to the slow verification process of asset circulation tracking data (Salsabila et al., 2024).

Although the company strives to maintain construction continuity, the slow process of preparing manual inventory reports from field posts to managerial units results in prolonged information delays. The conventional data recapitulation process is considered slow and requires an estimated completion time of two to three working days for each inspection period (Putri Ariansyah & Imaduddin, 2026). The impact of this slow information transmission chain causes logistics reports to be unavailable on a daily basis and instead submitted periodically on a weekly or monthly basis. This delay in report delivery creates uncertainty regarding the availability of operational materials. In many cases, material supplies in the field have already reached critical levels or become completely depleted, while management remains unaware because inventory movement data have not been digitally updated. Empirically, this non-integrated management of construction material inventory hinders project progress in the field and causes operational cost inefficiencies due to work delays (Lee et al., 2024).

The inaccuracy and inefficiency of logistics reporting ultimately have a highly significant negative impact on managerial decision-making processes. The automation of inventory recording through the implementation of information technology systems is urgently required to minimize the organization's administrative burden and reduce the potential for human error (Arvanullah & Kurniawati, 2024). Through the design of a computerized website optimized for desktop devices at warehouse posts, inefficient data-entry bureaucratic processes can be completely eliminated. The implementation of a website-based application system using the Laravel framework and a relational database has been proven to facilitate the management of incoming and outgoing goods in a fast, accurate, and transparent manner (Hidayat & Satria Putra, 2025). The primary shortcomings of the old system specifically its extreme vulnerability to physical logbook damage, high risk of ledger data loss, and handwriting errors represent critical operational liabilities. By integrating digital inventory reports, the company gains substantial benefits, providing real-time, centralized visibility over stock balances within the single warehouse to eliminate paper-based blind spots. Based on this urgency, this study aims to design and develop a Web-Based Project Material Inventory Information System at PT XYZ.

2. RESEARCH METHOD

The Waterfall method is a system development model that adopts a systematic and structured linear sequential approach (Fana Fauzan et al., 2024; Haryadi et al., 2025). The primary characteristic of this methodology lies in the execution of each development phase in a sequential manner, whereby a subsequent phase cannot commence until the preceding phase has been completed (Fadillah Agustio et al., 2024; Haryadi et al., 2025). In general, the system development process in the Waterfall model consists of requirements analysis, system design, implementation, testing, and maintenance phases (Fadillah Agustio et al., 2024). Each phase produces outputs that serve as the foundation for the next phase, enabling the development process to proceed in a structured and well-documented manner (Fana Fauzan et al., 2024; Haryadi et al., 2025). Therefore, the Waterfall model is considered suitable for projects with relatively clear and stable system requirements from the early stages of development, while also providing comprehensive and systematic project documentation (Fana Fauzan et al., 2024; Sari et al., 2025). As for the waterfall method development model, it is illustrated in the following picture:

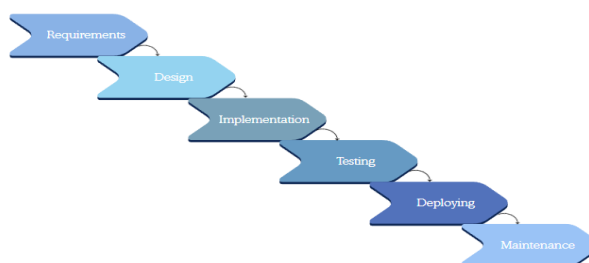


Figure 1. Waterfall method flow

- a. Requirements Analysis, this stage is the initial step to identify problems and gather complete system requirements. Problem Analysis: The author conducted observations and structured interviews with the company's warehouse personnel to systematically collect empirical data. The main problems identified within this single warehouse were manual handwritten logbook records, which directly resulted in inventory discrepancies and delays in report generation. Requirements Specification: Based on the analysis, the system requirements were defined to include digital recording features, automatic inventory validation to prevent negative stock, and access rights separation between Admin and Manager. To ensure accuracy, staff data-entry discipline must be controlled, with success measured by achieving zero stock discrepancy and a 100% testing pass rate.
- b. Design, this stage focuses on designing the software structure before the coding process is carried out. Workflow and Logic Design: The author designed the Proposed System Flowmap, Use Case Diagram, Activity Diagram, and Sequence Diagram to model the system workflow. Database Design: A database schema (Schema Builder) was designed, consisting of master tables (users, items, vendors, projects, and units) and transaction tables (incoming goods and outgoing goods). Interface Design: User Interface (UI) designs were created for the Dashboard page, Master Data page, Incoming and Outgoing Goods pages, transaction input forms, and report recapitulation tables.
- c. Implementation, this stage is the process of translating the design into program code. Coding: The author developed the system using the PHP programming language with the Laravel framework and a MySQL database. Key features such as Eloquent ORM were utilized to manage relationships between data entities, and stock automation logic was implemented within the Incoming Goods and Outgoing Goods Controllers.
- d. Testing, after the program code was completed, testing was conducted to ensure that the system was free from errors. Method: Testing was performed using the Black Box Testing method. Test Scenarios: The author tested system functionalities, including login validation (incorrect username/password), automatic stock calculations during transactions, edit and delete features, and report export functionality to PDF and Excel formats.
- e. Deployment, this stage is the process of delivering the tested software to users. Installation: The Inventory Information System was installed on the company's operational computers to ensure

readiness for use. The author also provided brief guidance to Warehouse Administrators regarding the use of the system features.

- f. Maintenance, this is the final stage aimed at maintaining system performance after deployment. Monitoring: The author conducted periodic monitoring to ensure system stability and to resolve minor bugs or technical issues that might be identified by warehouse administrators during the initial period of system usage.

3. RESULTS AND DISCUSSION

System design results

- a. Use Case Diagram, a Use Case Diagram is a visual modeling tool within the Unified Modeling Language (UML) that functions to illustrate the functional interactions between external actors and the system under development (Narulita et al., 2024). Through this graphical representation, developers can clearly map system boundaries and define the behavioral relationships that occur within the software environment. In the information system design phase, the utilization of this diagram is crucial for deeply identifying operational requirements from the perspective of the end-user (Fahrizal & Azhar, 2025). By separating roles and actor access rights in a structured manner, this diagram simplifies the formulation of functional test scenarios to ensure that all application modules operate in complete alignment with the planned initial specifications.

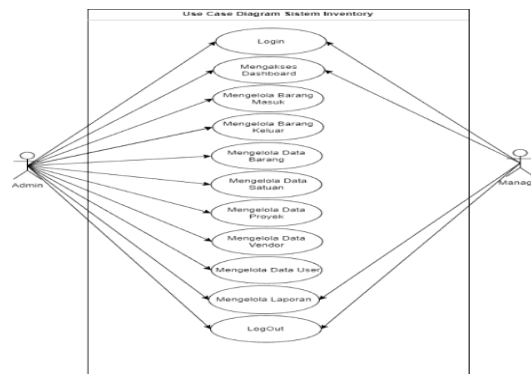


Figure 2. Use case diagram

- b. Activity Diagram, an Activity Diagram is a visual modeling tool in the Unified Modeling Language (UML) designed to illustrate the sequence of workflows or operational business processes within a system (Aji et al., 2025; Giri Nikmatullah et al., 2026). This diagram graphically demonstrates how an activity originates, the precise sequential steps executed by actors or the system, decision-making fork points, and ultimately how the system achieves its end state. Through this dynamic representation, the activity diagram enables developers to clearly comprehend the procedural logic of functional system interactions, such as the flow of warehouse logistics transaction processing or comprehensive data collection mechanisms.



Figure 3. Activity diagram

The login activity diagram process in Figure 3 starts when the user accesses the system, which is then responded to by the authentication page for entering a username and password. The system then validates the data by checking its match in the database through decision branching logic. If the entered data is not valid, the system automatically triggers an error message and returns the user to the authentication form. On the other hand, if the data is verified as correct, the system grants full access and directs the user to the main dashboard page as a sign of successful authentication

c. Class Diagram, a Class Diagram is defined as a diagram that shows the relationships between classes and provides detailed explanations about each class in a system's design model. This diagram displays the rules and responsibilities of entities that determine the system's behavior and serves as a visualization of the program system's structure. In addition, a Class Diagram serves to represent the flow of a database in the system that will be built. In it, a class is identified as an entity depicted in the form of a rectangle, containing the class name, attributes, and operation methods. This diagram is very important during the design phase because it helps capture the structure of all the classes that make up the system architecture and explains the types of objects and their relationships with other objects (Ramdany et al., 2024).

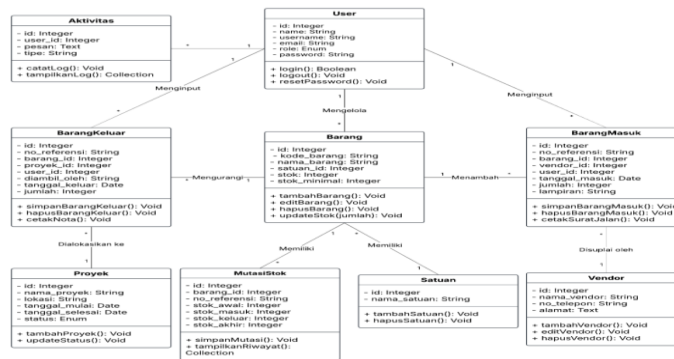


Figure 4. Class diagram

Based on the class diagram in Figure 4, the User class interacts with master and transaction data, while the Item class is related to Unit, Incoming Items, and Outgoing Items. Each incoming and outgoing transaction will be recorded in the Stock Mutation to maintain inventory data integrity. In addition, incoming item transactions are linked to Vendors as the source of materials, and outgoing items are linked to Projects as the destination for material usage. The methods used include add, edit, delete, and logMutation to automatically record stock changes.

Implementation

a. Login Page View, the login page is the main security gateway that works to restrict access rights to the system. This interface is designed minimally, requiring users to enter a valid username and password combination before they can manage inventory data. The system will validate the data against the database to make sure that only registered personnel can log in.

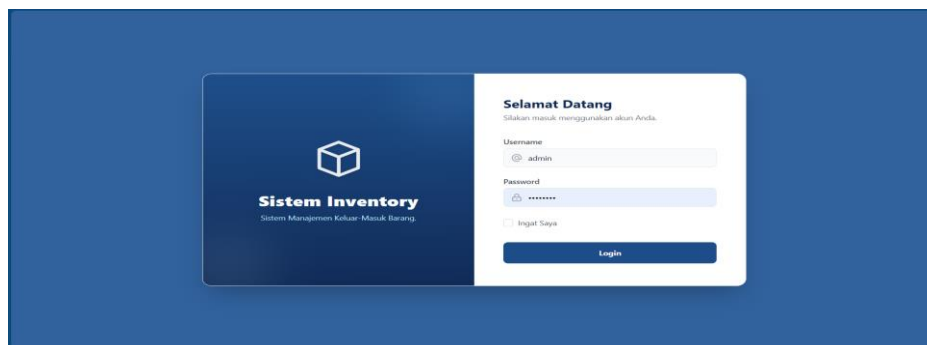


Figure 5. Login page interface

- b. Dashboard Page View, the dashboard page is designed as the main interface that presents a real-time summary of project material information to support monitoring and managerial decision-making. This interface integrates key indicator panels to quickly track essential metrics, including the accumulated quantity of different item types, total stock availability, and the volume of goods transactions in and out during the current month. In addition, the system's intuitive aspect is enhanced through interactive graph-based data visualizations that map comparisons of goods movement, percentage distribution of inventory types, and material availability status ratios. Transparency and warehouse operational security are also optimized through a monitoring panel equipped with features such as user transaction activity logs and an early warning system to detect stock conditions approaching critical limits, helping minimize the risk of material shortages in the project area.

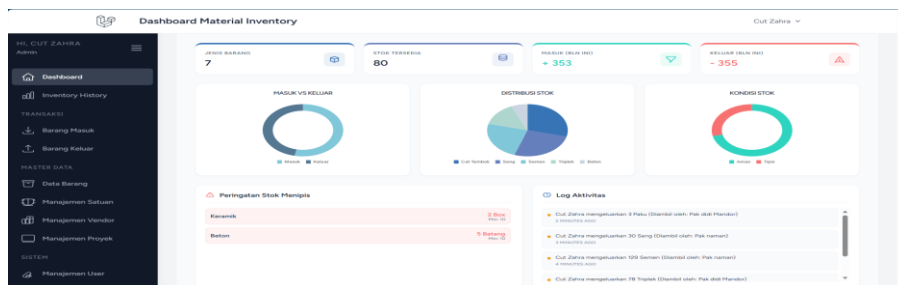


Figure 6. Dashboard page interface

- c. Item Data Page View, this page serves as a centralized database that integrates all fundamental information about material specifications and project inventory volumes. The interface is designed to make logistics management easier by automatically visualizing stock balances, providing a summary of items coming in and going out, as well as the remaining stock in real time. Additionally, the system comes with a threshold notification mechanism using visual indicators in the minimum stock column, which helps give administrators early warnings when supplies start running low.

KODE	NAMA BARANG	QTY IN (+)	QTY OUT (-)	AKHIR	SATUAN	MIN	Aksi
B-008	Triplek	+89	-78	11	Lembar	10	Edit Hapus
B-001	Beton	+120	-115	5	Batang	10	Edit Hapus
SG-001	Seng	+50	-30	20	Lembar	10	Edit Hapus
CT-001	Cat Tembok	+0	-0	22	Kaleng	10	Edit Hapus
PK-001	Paku	+5	-3	2	Rig	1	Edit Hapus
K-001	Keramik	+0	-0	2	Box	10	Edit Hapus
S-001	Semen	+89	-129	18	Sak	10	Edit Hapus

Figure 7. Item data page interface

- d. Incoming Goods Page View, this Incoming Goods Data page acts as the main gateway for recording every material asset received from suppliers (vendors). The interface of the incoming goods page is shown in Figure 8.

TGL MASUK	REF/VI	KODE	BARANG	VENDOR	JUMLAH	KETERANGAN	DIMINT OLEH	LAMPIRAN	Aksi
08/06/2026	SJ-2026/06-PK-02	PK-001	Paku	CV Sumber Bangunan	+5 Rig	Barang sampai d...	Cut Zahra	Libat	Edit Hapus
06/06/2026	SJ-2026/04-SG-002	SG-001	Seng	Toko Material Serba Ada	+50 Lembar	Barang aman	Cut Zahra	Libat	Edit Hapus
06/06/2026	SJ-2026/05-003	S-001	Semen	CV Sumber Bangunan	+89 Sak	Barang aman	Cut Zahra	Libat	Edit Hapus
01/06/2026	SJ/2026/05-002	B-008	Triplek	Toko Material Serba Ada	+89 Lembar	Barang masuk de...	Cut Zahra	Libat	Edit Hapus
01/06/2026	SJ-2026/04-B001	B-001	Beton	CV Sumber Bangunan	+120 Batang	Barang diterima L...	Cut Zahra	Libat	Edit Hapus
07/05/2026	SJ-2026/04-K-001	K-001	Keramik	Toko Material Serba Ada	+100 Box	Barang Sampai d...	Cut Zahra	Libat	Edit Hapus
06/05/2026	SJ-2026/04-CT-001	CT-001	Cat Tembok	CV Sumber Bangunan	+100 Kaleng	Barang sampai d...	Cut Zahra	Libat	Edit Hapus

Figure 8. Incoming goods page interface

- e. Outgoing Items Display, this page is used to manage the distribution of materials to the construction project sites being worked on. The interface of this page can be seen in Figure 9.

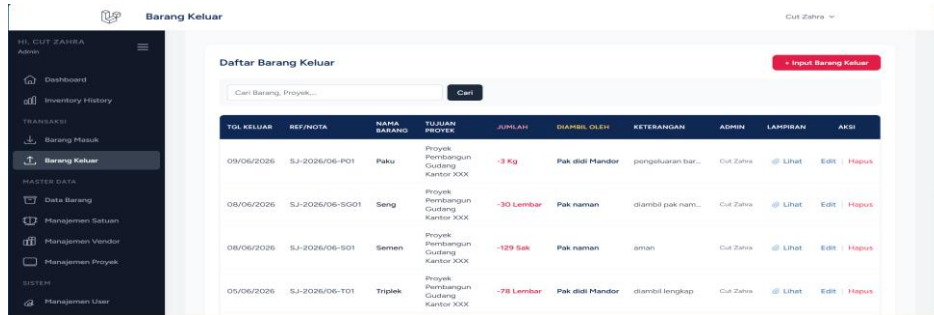


Figure 9. Outgoing items page interface

- f. Inventory History Page View, the Inventory History page serves as a centralized reporting module that provides a chronological recap of all logistics activities to maintain transparency in company asset movements. This interface comes with a report category filter to separate data by transaction type, such as incoming goods, outgoing goods, and stock mutations, as well as a date range filter to narrow down searches by a specific period. Additionally, this module offers a dynamic report printing feature that allows documents to be downloaded in PDF and Excel formats flexibly according to the selected parameters. Specifically for stock mutations, the system automatically presents calculations comparing beginning stock, accumulated incoming and outgoing goods, and the ending balance to ensure real-time inventory data accuracy.

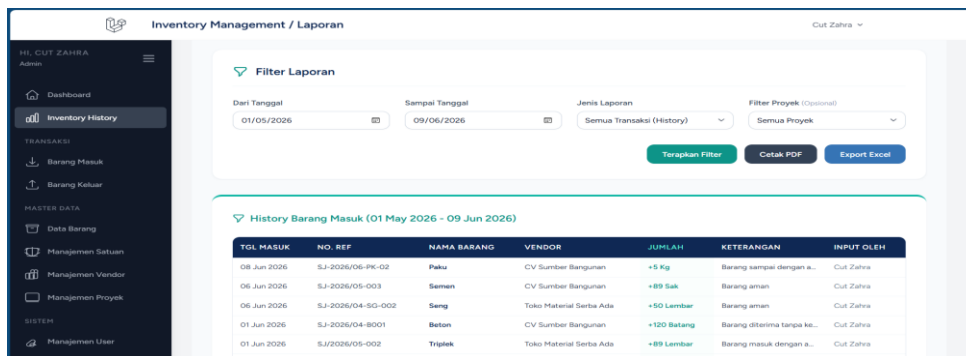


Figure 10. Inventory history page interface

- g. Inventory Report View, figure 11 shows the material inventory report for June 2026, which includes a stock mutation summary and a record of incoming goods. In the stock mutation summary, the beginning stock column represents the inventory balance left at the end of May 2026 and becomes the starting balance for June. The system automatically calculates the ending stock based on the accumulation of incoming (Qty In) and outgoing (Qty Out) transactions during the period. In addition, the incoming goods history report provides detailed information about the transaction date, reference number, vendor, quantity of goods received, and transaction notes.

Figure 12 shows the report of outgoing goods history, which contains information related to the transaction date, reference number, item name, destination project, quantity of items issued, notes, and the user who entered the data. This report serves as documentation of material distribution to project sites and also supports the process of supervising and controlling inventory usage in an integrated way.

LAPORAN INVENTORY MATERIAL
PT XYZ
Periode: 01 Jun 2026 - 08 Jun 2026

Rekap Mutasi Stok Material

NAMA MATERIAL	SATUAN	STOK AWAL	QTY IN DA	QTY OUT DA	STOK AKHIR
Beton	Batang	0	120	115	5
Cat Tumbuk	Kantong	20	10	0	30
Kawat	Roll	2	10	0	12
Plaku	Kg	0	15	0	15
Semen	Sak	50	100	120	30
Seng	Lembar	0	100	0	100
Triglas	Lembar	0	100	70	30

History Barang Masuk

TGL MASUK	NO. REF	NAMA BARANG	MENYOR	JUMLAH	KETERANGAN	INPUT OLEH
01-06-2026	SJ-202606-PK-02	Plaku	CJ Sumber Bangunan	15 Kg	Barang masuk dengan aman	Cat Zaino
04-06-2026	SJ-202606-003	Semen	CJ Sumber Bangunan	100 Sak	Barang aman	Cat Zaino
05-06-2026	SJ-202606-101-002	Seng	Toko Material Sinar Asia	100 Lembar	Barang aman	Cat Zaino
01-06-2026	SJ-202606-80001	Beton	CJ Sumber Bangunan	120 Batang	Barang diterima dengan aman	Cat Zaino
01-06-2026	SJ-202606-1002	Triglas	Toko Material Sinar Asia	100 Lembar	Barang masuk dengan aman dan lengkap	Cat Zaino

Figure 11. Stock and incoming goods report

History Barang Keluar

TGL KELUAR	NO. REF	NAMA BARANG	PROJEK TUJUAN	JUMLAH	KETERANGAN	INPUT OLEH
05-06-2026	SJ-202606-101	Plaku	Proyek Pembangunan Gedung Kantor XXX	3 Kg	Pengiriman barang-barang pak 001	Cat Zaino
04-06-2026	SJ-202606-101	Semen	Proyek Pembangunan Gedung Kantor XXX	120 Sak	aman	Cat Zaino
04-06-2026	SJ-202606-10001	Seng	Proyek Pembangunan Gedung Kantor XXX	100 Lembar	barang pak kirim ke gud	Cat Zaino

History Barang Keluar (lanjutan)

TGL KELUAR	NO. REF	NAMA BARANG	PROJEK TUJUAN	JUMLAH	KETERANGAN	INPUT OLEH
05-06-2026	SJ-202606-101	Triglas	Proyek Pembangunan Gedung Kantor XXX	70 Lembar	barang pengiriman	Cat Zaino
01-06-2026	SJ-202606-801	Beton	Proyek Pembangunan Gedung Kantor XXX	115 Batang	Pengiriman barang ke proyek	Cat Zaino

Figure 12. Outgoing goods report

This system accelerates item searching from minutes to seconds, minimizes math human errors via database validation, and tracks mutations chronologically to optimize stock opname audits.

Testing

Black Box Testing is a software evaluation method that focuses entirely on system functionality without needing to examine its internal program code structure (Abdillah et al., 2024; Kinasih et al., 2026). This approach is conducted by providing specific input data and subsequently verifying whether the resulting output aligns with the users' requirements specifications (Iman Nugraha et al., 2025). Through techniques such as Equivalence Partitioning, this testing is highly effective in detecting database anomalies, functional errors in transaction modules, and authentication issues (Abdillah et al., 2024; Kinasih et al., 2026). Implementing this method is crucial to ensure that applications can operate optimally, validly, and free from system failures when utilized by end-users (Iman Nugraha et al., 2025; Kinasih et al., 2026).

Table 1. Testing

Module / Feature	Test Scenario	Expected Result	Status
Authentication	Login with valid credentials	User is redirected to the Dashboard page.	Success
Item Master Data	Reject duplicate item data	Duplicate item code is rejected.	Success
Item Master Data	Validate relational data integrity	Deletion of linked data is blocked.	Success
Incoming Items	Validate file attachment	Transaction data is successfully saved.	Success
Outgoing Goods	Validate minimum stock limit	Transaction is rejected when stock is insufficient.	Success
Outgoing Goods	Transaction cancellation	Stock is automatically restored after cancellation.	Success
Reports (History)	Export report data	PDF and Excel reports are successfully generated.	Success

4. CONCLUSION

Based on the research, design, and testing carried out on the inventory information system at PT XYZ, it can be concluded that this study has successfully designed and built a web-based inventory information system using the Waterfall method and the Laravel framework. This system successfully digitizes master data and centralizes recording of incoming and outgoing transactions, effectively replacing the manual system. The stock automation feature has been successfully implemented, where the system automatically updates the stock balance whenever there is a movement of goods and provides real-time reports on material usage history that can be exported to PDF/Excel formats. User access management has been successfully applied by separating authorities between Admin accounts (for warehouse operational input) and Manager accounts (for report monitoring), thus improving data integrity and security at PT XYZ. Practically, this implementation provides management with data visibility to prevent project delays, with future recommendations focusing on continuous digital transformation through automated WhatsApp alerts, QR/barcode scanning, and project scheduling module integration.

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