Journal of Information System and Technology Research

journal homepage: https://journal.aira.or.id/index.php/jistr/

Optimization of Motorcycle Spare Parts Inventory Management to Improve Stock Availability and Control

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ARTICLE INFO

Article history:
Received Oct 1, 2021
Revised Dec 10, 2021
Accepted Jan 25, 2022
Available online Jan 31, 2022

Keywords:
Information System
Inventory
Web
Waterfall
FIFO

ABSTRACT

Inventory management at PT. Harmony Abadi Sejahtera was performed manually, resulting in data inconsistencies, delays in stock updates, recording errors, and difficulties in preparing inventory reports. These problems reduced the accuracy and efficiency of spare parts inventory control. This research aims to improve inventory management efficiency and accuracy through a structured stock management approach.A case study research design was employed using primary and secondary data obtained through observation, interviews, and inventory documentation. The research involved identifying inventory problems, analyzing operational requirements, implementing an inventory solution, and evaluating its performance. FIFO (First In, First Out) was applied to regulate stock issuance, while Reorder Point was used to support replenishment. Functional performance was evaluated using Black Box Testing, while effectiveness was assessed based on stock accuracy, recording consistency, and reporting efficiency.The evaluation showed a 100% success rate across tested inventory processes. The proposed approach improved stock recording structure and timeliness, supported FIFO-based stock issuance, and provided inventory information for replenishment decisions. It also reduced recording inconsistencies compared with manual procedures.The findings indicate that integrating FIFO and Reorder Point can improve inventory control and operational efficiency. Further quantitative evaluation of recording time, stock discrepancies, stockout frequency, and reporting time is recommended.

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1. INTRODUCTION

An inventory information system is a system designed to record, manage, and monitor inventory data within a company in a structured manner. This system plays a crucial role in helping companies determine the condition of available and low inventory. Inventory significantly contributes to the smooth operation of a company because it directly relates to the logistics needs of each division. Implementing an inventory information system allows companies to minimize errors such as data duplication and inaccurate stock recording. Furthermore, this system also supports fast, accurate, and efficient inventory data reporting. The resulting information serves as a crucial basis for decision-making, particularly in procurement, storage, and distribution of goods. Therefore, implementing an inventory information system is essential for effective, efficient, and well-organized company operations. In line with this,[1] state that inventory data reporting is a crucial aspect of any organization, company, or government agency. Through this report, the existence and condition of inventory in each division or section can be determined more clearly and measurably.

PT Harmony Abadi Sejahtera is a company engaged in vehicle service and the sale of Yamaha-branded spare parts. In its operational activities, the company still implements a manual inventory management system, namely by recording demand and inventory using paper sheets and Microsoft Excel applications. This manual method creates various obstacles,

including lost transaction data, delays in stock updates, and discrepancies between reports and actual stock conditions in the warehouse. These problems impact the company's operational processes and have the potential to cause an imbalance between the availability and demand of spare parts for customers. Similar findings were also expressed by [2], who stated that at the Banyumas Regency Transportation Agency, inventory data processing processes, such as item data collection, recording item conditions, searching, and data recapitulation, still face obstacles due to the large number of items that must be recorded. This condition causes some items to escape supervision, thus complicating the process of monitoring and controlling inventory effectively.

At PT Harmony Abadi Sejahtera, the process of managing motor vehicle spare part inventory is still carried out manually. Stock data is recorded using Microsoft Excel and physical paper documents. This method is considered inefficient because it requires a relatively long time and a high level of accuracy in the recording process.A well-managed goods control system will have a good impact on the business actors themselves. If the control system is not good, of course it will result in goods stock that does not match the physical stock, which will cause the company to experience losses[3]. Furthermore, this manual system carries a high risk of typographical errors, data duplication, and discrepancies between recorded stock data and the physical stock conditions in the warehouse. As a result, the process of checking spare part availability is slow, resulting in service delays and decreased sales efficiency. Therefore, a web-based inventory information system is needed that can record, update, and present stock data automatically, structured, and in real-time. According to [4], an inventory system plays a crucial role in supporting the sales process, as it must be able to present information regarding merchandise inventory—including expenditure, purchasing, receipt, and distribution data—quickly and accurately to support effective decision-making.

Research conducted by [5] showed that inventory management at CV Sinar Abadi Cemerlang is still carried out manually, from recording incoming goods and requisitioning goods by the sales department to issuing goods by the warehouse and generating reports. The researchers developed an information system using the Waterfall development method with Black Box Testing. The system was built using the PHP programming language and a MySQL database, with key features including login management, managing goods and supplier data, purchasing and sales transactions, and inventory reporting. The managed goods are general merchandise stored and sold by a wholesale company, with the main actor in the system being the admin.

Furthermore, research by [6] addressed similar issues in inventory management at Toko Sembako AA, where the process of recording stock, purchasing and sales transactions, and preparing financial reports is still done manually. This condition results in an inefficient and time-consuming process. This research also used the Waterfall development method with Black Box Testing. The system was developed using the CodeIgniter 3 framework, PHP, and MySQL. The implemented features include input for purchases, sales, returns, transaction approvals, financial reports, and user and item pricing management. The items managed are basic necessities, such as rice, sugar, oil, and other basic necessities, with the actors involved including customers, admins, and store owners.

Research conducted by [7] also encountered problems with the manual and inaccurate manual spare parts recording process. The researchers used the Waterfall development method with Black Box Testing to design a web-based system using PHP and MySQL, with an interface designed using Figma. Key features of the system include real-time stock management, category-based spare parts tracking, automatic search, adding product images, data export to PDF format, and a multi-level dashboard for admins and staff. The items managed in this study were motorcycle spare parts owned by PT Astra Honda Motor, with the goal of improving the efficiency and accuracy of spare parts data management.

Meanwhile, research by [8] aimed to develop an inventory information system at the Mekarsari Minimarket using the Waterfall method. This system is designed to assist inventory management and support business decision-making. Although system testing is not described in detail, the development approach adheres to the standard Waterfall stages. The main features developed include recording incoming and outgoing goods, stock monitoring, inventory reporting, and inventory data management. The types of goods managed are retail products and daily necessities, with the primary actor in the system being the administrator.

Research conducted by [9] addresses the problem of manual record-keeping in the Sinergi Co-Working cafe and co-working space, including recording raw materials, incoming goods, outgoing goods, and managing damaged or failed goods. Manual management leads to recording errors and stock buildup in the warehouse. The system developed in this study uses PHP and MySQL with Black Box Testing. Features include login management for barista and manager roles, recording incoming and outgoing goods based on the FIFO (First In First Out) method with reference to the date of entry, ordering from suppliers, inventory reporting, and CRUD features for users. The items managed include raw materials and cafe operational supplies such as food, beverages, and bar equipment, with system actors including the captain barista and manager.

This research focuses on creating a web-based spare parts inventory system at PT Harmony Abadi Sejahtera to enhance the accuracy of inventory records, monitor stock effectively, and improve reporting efficiency by utilizing the FIFO method. The system is built with the Waterfall development approach, utilizing PHP technology through the CodeIgniter framework along with a MySQL database, which has been shown to be dependable in earlier studies. The introduction of this system is anticipated to simplify the procedure of documenting and presenting inventory in an organized way, thus reducing human mistakes like data redundancy and information loss. In addition, implementing the FIFO (First

In First Out) method in inventory management is anticipated to ensure that items are handled according to their arrival and departure order, thereby enhancing the accuracy and efficiency of inventory distribution.

This research presents a novel element in the context of the system implementation at PT Harmony Abadi Sejahtera, a company engaged in vehicle service and the sale of Yamaha motorcycle spare parts. The managed inventory focuses on motorcycle spare parts, with the development of a key feature in the form of a dynamic table that allows for the simultaneous input of large amounts of spare part data, along with an automated stock recording system to improve operational efficiency. This system also involves two main actors: the spare parts administrator and the service administrator, who have distinct responsibilities for managing and monitoring inventory. One innovative aspect of the developed system is the implementation of the FIFO algorithm in the outgoing goods module, where the first items entered into the system are the first to be issued. This approach aims to improve the orderliness of stock management, prevent damage to goods due to overstorage, and ensure the availability of spare parts as needed.

Manual inventory management, including that at PT Harmony Abadi Sejahtera, often results in various problems such as data inconsistencies, delays in stock updates, and errors in preparing inventory reports. These conditions have the potential to hamper operational performance and reduce the effectiveness of managerial decision-making. Based on previous research findings demonstrating the effectiveness of web-based inventory systems in addressing similar issues, this study focuses on the development of a web-based inventory system designed to replace the manual system at PT Harmony Abadi Sejahtera, specifically in the spare parts warehouse sector, with the aim of improving accuracy, efficiency, and reliability in inventory management.

2. RESEARCH METHOD

2.1 Inventory

Stock represents a key part of a company's short-term assets and is essential to how the business runs day-to-day. When you look at how much of a company's total assets are tied up in inventory, it really shows just how important it is for keeping production lines moving and getting products out to customers without any hiccups. Basically, inventory comes in different types - you've got your raw materials waiting to be turned into something, items that are halfway through the manufacturing process, and completed products that are all set to be sold to customers [10] .

2.2 Inventory System

An inventory system is basically a set of rules and control methods that help businesses keep track of their stock levels, manage what they have on hand, and figure out the best amounts to keep in storage, including when and how much to reorder. The inventory information system itself includes connected parts that work together to collect, process, store, and share data to help companies make better decisions and keep an eye on their day-to-day operations [9].

2.3 Waterfall Method

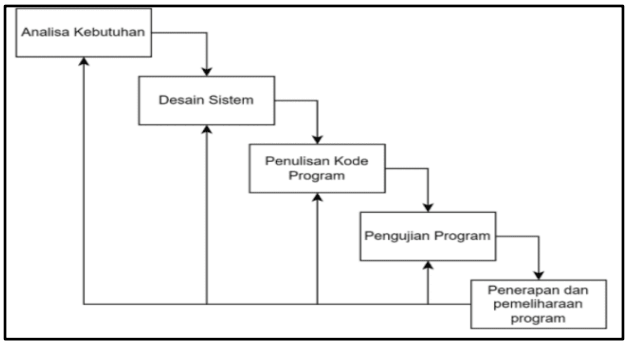

Figure.1. Stages of the Waterfall Method[11]

The waterfall methodology constitutes a software development framework characterized by systematic and sequential progression through distinct phases, commencing with analysis and culminating in maintenance. Each developmental stage must be completed in its entirety prior to proceeding to the subsequent phase, thereby establishing a linear workflow that resembles the cascading nature of a waterfall [12].

1. Requirements Analysis

This phase involves the identification of user requirements and the determination of system specifications for the proposed development. The outcomes of this stage serve as the foundation for subsequent phases [13].

2. System Design

Represents a comprehensive multi-phase methodology that concentrates on the architectural development of software applications, encompassing data structure frameworks, software architecture paradigms, interface representation protocols, and coding procedural methodologies [14].

3. Implementation or Program Code Development

Implementation refers to the existence of activities, actions, operations, or systematic mechanisms that lead to not merely isolated activities, but rather strategically planned endeavors and deliberate actions undertaken to achieve specific objectives[15].

4. Testing

Testing constitutes a fundamental component of software development processes. Its primary objective is to establish the functional parameters of software applications and to ensure that the resulting software products meet the quality standards anticipated by end users [16].

5. Maintenance

Program testing, integration, and verification to see if the system is ready to meet the desired requirements[17].

2.4 Fifo Algorithm

The First In First Out (FIFO) methodology constitutes an inventory recording system that operates under the assumption that goods received initially shall be distributed first. The objective of this approach is to align the physical flow of merchandise to ensure inventory remains fresh and is not retained in warehouse facilities for extended periods. Consequently, products with the nearest expiration dates are released earlier, thereby maintaining inventory quality standards and minimizing deterioration risks [9]. According to research conducted by , the calculation of Cost of Goods Sold using the First In, First Out method is determined by the formula: Cost of Goods Sold equals goods available for sale minus ending inventory.Using the FIFO method, the resulting cost of goods sold is lower than using the Average method. A lower cost of goods sold will result in higher company profits[18].

2.5 PHP

PHP is a programming language used to translate lines of code into instructions that can be understood by the computer on the server side, and it can be embedded into HTML. PHP is a web-based programming language widely used by web developers to build dynamic web applications.PHP has a server-side nature, meaning that the execution of PHP code is performed on the server. Server-side execution means that PHP code runs on the server computer rather than on the client's computer (user). The results of this process are then sent to the client in the form of a processed web page[19].

2.6 UML

The Unified Modeling Language (UML) is a standard specification language used to document, specify, and build software. UML is a methodology for developing object-oriented systems and is also a tool to support system development[20] .standard specifications used to document, specify and build software. UML is a methodology for developing software [21].UML is a modeling language used to design, document, and visualize software systems. UML consists of four main types of diagrams. The Use Case Diagram.The Activity Diagram. The Sequence Diagram. The Class Diagram[22].

2.7 BLACKBOX TESTING

The black box method is used to test each feature of the website in software testing. It focuses on testing the software's functionality, allowing testers to evaluate how the system responds to various specific inputs in each form to determine whether it meetsthe planned specifications. The black box method is frequently used to test multiple aspects of software, including functionality, performance, and security[23].

2.8 USECASE DIAGRAM

Use Case Diagrams are used to illustrate the interactions between actors and the system being developed. These diagrams show the main functions accessible to users and the relationships between actors and the system[24].

6. RESULTS AND DISCUSSION

3.1 Research Stages

figure 3.1 Research Stages

Figure 3.1 explains that the first stage is collecting the final project (thesis) title, followed by the next step, which is requirements analysis using the Waterfall method through interview and observation techniques. The interviews were conducted with two main informants, namely the service administrator and the spare parts administrator, in order to identify existing problems. The next step is to determine the problem formulation and research objectives. Based on the results of the interviews and observations, the research problems are formulated as follows:

1. How is the system modeled to design a spare parts inventory system at PT. Harmony Abadi Sejahtera?
2. How to develop an inventory system for managing spare parts at PT. Harmony Abadi Sejahtera?
3. How to test the main functional features of the developed inventory system?

From the formulated problems, the research objectives are to develop a web-based inventory system and to test it using Black Box Testing. After the problems and objectives are defined, the system design and implementation are carried out. The design uses UML diagrams consisting of Use Case Diagram, Activity Diagram, Class Diagram, and Sequence Diagram, which are created using draw.io (web-based) and Diagram Paradigm software. Meanwhile, the UI (User Interface) design is created using Figma.

For implementation or coding, the system is developed using the Visual Studio Code text editor, the PHP (Hypertext Preprocessor) programming language version 8.2.12, and the CodeIgniter 4 framework, with MySQL as the database, running through Laragon. This research was conducted using an Asus Vivobook 14 laptop with an AMD Ryzen processor, 8 GB RAM, and the Windows 11 Home Single Language OS.The next step is conducting Black Box Testing to ensure that the system works according to the designed functionality. The final stages are preparing the final project report, and the last stage is writing a journal article as the final research output.

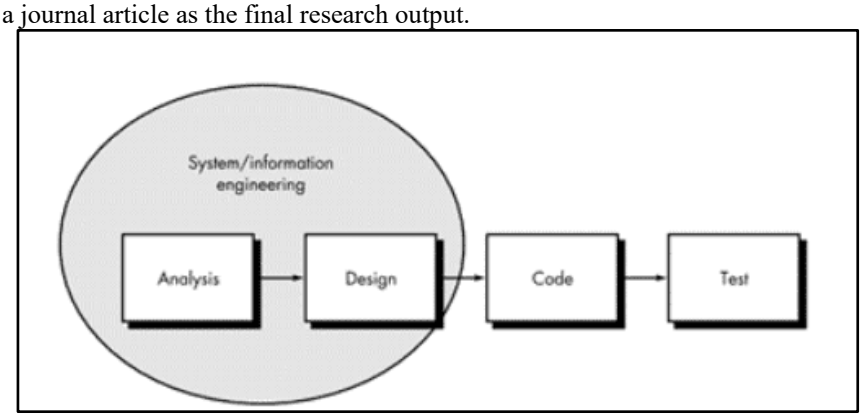

Figure 3.2 Waterfall Method**[8]**

The Waterfall method is a systematic approach to software development that consists of several stages, namely planning, system analysis, system design, system development, and system testing [4]. However, in the research conducted at PT. Harmony Abadi Sejahtera, the stages were only carried out up to the testing phase and did not reach the maintenance phase. The waterfall model was chosen because it is considered capable of producing a software system that meets these needs[25].

1. Requirements Analysis
   At the requirements analysis stage, both quantitative and qualitative methods were used. The combination of these two methods is known as a mixed-method approach. Data collection techniques included interviews with two related informants, namely the service administrator and the spare parts administrator, observations, literature studies, and spare parts data in the form of Microsoft Excel files. Through these activities, the required system features, business processes, and functional and non-functional requirements were identified.
2. System Design

After completing the requirements analysis stage, the next step was the system design process. At this stage, the system design was developed using Unified Modeling Language (UML) to describe the involved actors and their access to system features, including the business process flow. The diagrams included Use Case Diagrams, Activity Diagrams, Class Diagrams, and Sequence Diagrams, which were created using Draw.io and Visual Paradigm 17.2.

In addition, the User Interface (UI) design was carried out by creating mockups using tools such as balsamig wireframes. This design served as an initial illustration of the system layout, including the placement of buttons and main features to be used by users, and became a reference for system development.

3. Implementation / Coding

After the mockup and system modeling stages were completed, the next step was system implementation. The implementation was carried out through coding using the PHP programming language version 8.2.12 and the CodeIgniter 4 framework as the main development framework. To support the user interface, HTML, CSS, and JavaScript technologies were used, written using the Visual Studio Code text editor to create responsive and interactive designs.Meanwhile, MySQL was used as the database management system to store all system-related data, and Laragon was used to run MySQL

4. Testing

After the system implementation or coding process was completed, the next stage was system testing to ensure that the system ran according to the designed functionalities. The testing was conducted using the Black Box Testing method, that emphasizes system performance without looking into the inner workings of the program code structure.In this method, the tester only provides input and observes the produced output to ensure that each feature or system function works properly and meets user requirements. Black Box Testing aims to identify functional errors, validate input–output processes, and ensure that the system meets the expected specifications.

3.2 Usecase Diagram

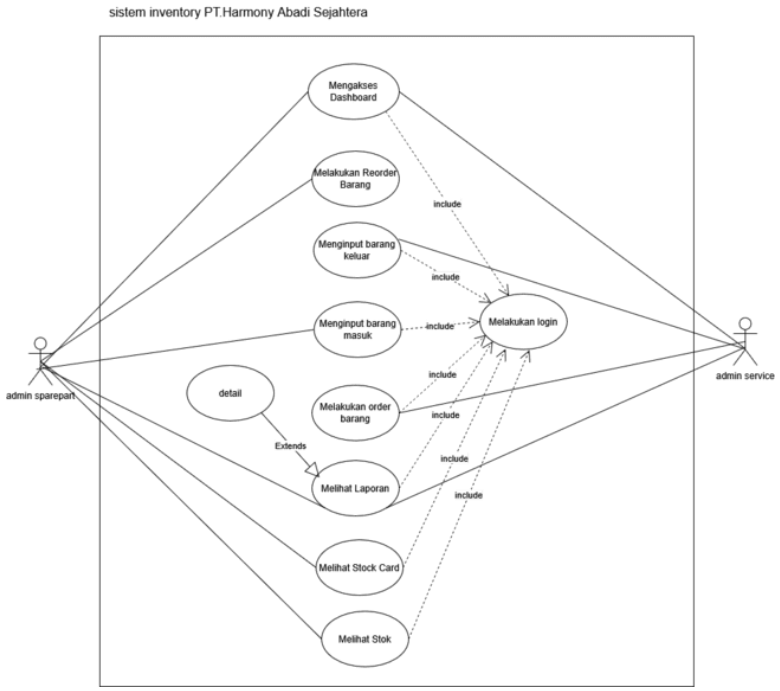

Figure 3.3 Usecase Diagram inventory system

The proposed system implements a role-based inventory management mechanism involving two primary actors: the Spare Parts Administrator and the Service Administrator. The system begins with an authentication process, where users provide valid credentials that are verified by the system before access is granted according to user roles. Error handling is applied when invalid credentials or CAPTCHA input is detected.

The system supports core inventory operations, including outgoing goods processing, where stock is deducted automatically using a FIFO-based batch mechanism, and transaction records are stored in the database. The reorder function enables real-time stock monitoring and generates automated reorder

notifications when stock levels reach predefined thresholds. Confirmed reorders are processed through the order management feature and persistently stored in the system database.

Incoming goods transactions are managed through a batch-based stock increment process, including supplier data input and validation. The system also provides real-time stock monitoring and a stock card module that records and displays detailed inventory movement histories to ensure data accuracy and traceability.

Furthermore, the system generates role-based analytical reports, including incoming and outgoing goods reports, cost of goods sold (HPP), and financial reports. Access to reports is restricted through authorization control to maintain data security. All system functions were validated using Black Box Testing to ensure compliance with functional requirements and system reliability.

3.3 Implementation of the System and Results

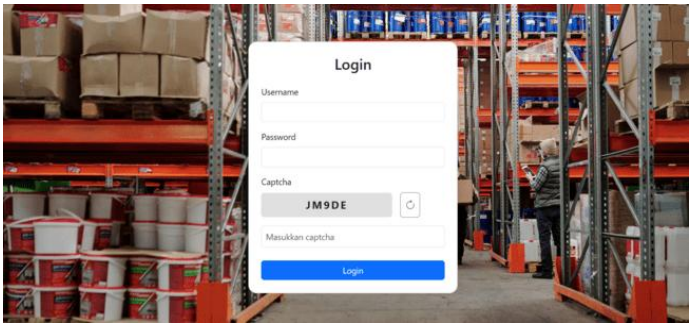

Figure 1 Login Page

Figure 1 explains that the login page contains a username, password, and captcha. If any of these inputs are incorrect, an error message will be displayed. If all inputs are correct,the user will be taken to the dashboard page according to the respective user.

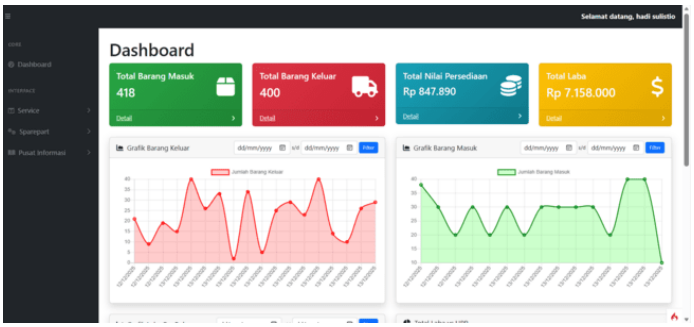

Figure 2 Dashboard Monitoring

Figure 2 shows the monitoring dashboard, which contains the total incoming goods, total outgoing goods, total inventory value, total profit, charts of total incoming goods, charts of total outgoing goods, and reorder point information.

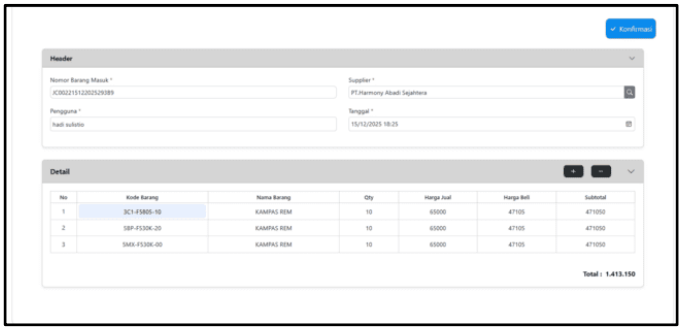

Figure 3 Stock Receiving Entry Page

Figure 3 shows the incoming goods input page, where the user inputs the supplier and the incoming goods data. If the supplier or quantity has not been entered, the system will reject the data from being saved. The table on this page is implemented as a dynamic table that can be added to or removed as needed.

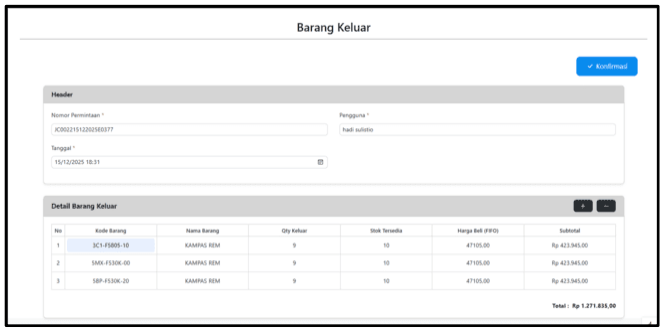

Figure 4 Stock Out Entry Page

Figure 4 shows the outgoing goods input page, which displays the name of the user who performs the input. The user is automatically adjusted based on the account that is logged in and accessing the system. This page also includes an automatically generated request code, as well as the input date and time. The input form applies a dynamic table that can be added to or removed as needed. If the entered quantity exceeds the available stock, the system will reject the data from being saved.

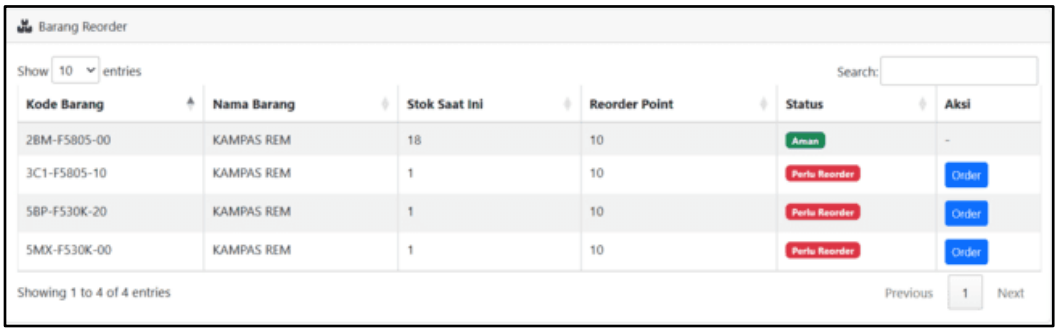

Figure 5 Reorder Poin Page

Figure 5 shows the reorder point display. When the stock level is less than 10, the system will display a status indicating that the item needs to be reordered and provide an order button. If the stock level is greater than 10, the status will be shown as safe. When items with stock levels below 10 are added to the order list and moved to the order page, the status will change to pending. After the items have been ordered by the service administrator, the status will change to ordered to prevent excessive ordering.

3.4 Blackbox Testing

Table 1 Black Box Testing Login Page

No	Testing Activity	Expected Result	Test Result	Conclusion
1	valid login with correct CAPTCHA	user is authenticated and redirected to dashboard	login succesful	Succeed
2	invalid password with correct CAPTCHA	system displays credential error message	error message displayed	Succeed
3	valid username and password with incorrect CAPTCHA	login denied due to CAPTCA error	CAPTCHA error shown	Succeed

Table 2 Black Box Testing Dashboard Monitoring

No	Testing Activity	Expected Result	Test Result	Conclusion
1	Access the dashboard page	The dashboard page is displayed successfully	Dashboard displayed correctly	Succeed
2	View dashboard summary totals (incoming goods, outgoing goods, inventory value, and profit)	The system displays all summary totals correctly based on stored transaction data	All summary totals displayed correctly	Succeed
3	View incoming and outgoing goods charts with date filter	The system displays incoming and outgoing goods charts correctly and updates them based on the selected date range	Charts displayed and updated correctly	Succeed
4	Access dashboard based on user role	Authorized users can access the dashboard according to their role	Role-based access works correctly	Succeed

Table 3 Black Box Testing Stock Receiving Entry Page

No	Testing Activity	Expected Result	Test Result	Conclusion
1	Select an existing supplier	The selected supplier information is displayed correctly	Supplier displayed correctly	Succeed
2	Add a new supplier	The system successfully saves and displays the new supplier	New supplier added successfully	Succeed
3	Input an invalid spare part code	The system automatically fills the spare part data in the form	Spare part data filled correctly	Succeed
4	Add and remove rows in the dynamic table	The system allows rows to be added or removed as needed	Dynamic table functions correctly	Succeed
5	Submit valid incoming goods data	The system successfully saves the data and increases the stock quantity	Stock increased successfully	Succeed

Table 4 Black Box Testing Stock Out Entry Page

No	Testing Activity	Expected Result	Test Result	Conclusion
1	Access the outgoing goods input page after login	The page is displayed with the logged-in user name, request code, and input date/time generated automatically	Page and automatic data displayed correctly	Succeed
2	Add and remove items using the dynamic table	The system allows rows to be added or removed as required	Dynamic table works correctly	Succeed
3	Input valid outgoing goods data with sufficient stock	The system saves the transaction successfully	Data saved successfully	Succeed
4	Input quantity exceeding available stock	The system rejects the input and displays a stock availability error message	Error message displayed	Succeed
5	Submit the form with incomplete or invalid data	The system prevents submission and displays validation warnings	Validation warnings displayed	Succeed

Table 5 Black Box Testing Reorder Poin

No	Testing Activity	Expected Result	Test Result	Conclusion
1	View item status based on stock level	Items with stock less than 10 are displayed with a “Reorder” status and an order button, while items with stock greater than 10 are displayed with a “Safe” status	Item status displayed correctly based on stock level	Succeed
2	Add items with stock less than 10 to the order list	The system moves the selected items to the order page and updates the status to “Pending”	Items moved to order page and status updated to Pending	Succeed
3	Confirm order by service administrator	After the order is confirmed, the system updates the item status to “Have Ordered” to prevent duplicate ordering	Status updated to Have Ordered successfully	Succeed

7. CONCLUSION

This study demonstrates that the proposed web-based spare parts inventory management approach improves the efficiency, accuracy, and traceability of inventory control at PT. Harmony Abadi Sejahtera. The main research contribution is the integration of FIFO-based stock issuance, real-time stock monitoring, reorder point calculation, and inventory reporting into a unified management process. This approach addresses limitations of spreadsheet- and paper-based inventory practices by providing structured data management and supporting more informed inventory control and procurement decisions.The system provides eight core functionalities, including incoming and outgoing goods recording, real-time stock information, FIFO-based inventory processing, reorder point calculation, financial reporting, cost of goods sold analysis, and goods movement reporting. UML modeling using Use Case, Activity, and Class Diagrams supported the representation of system processes, user interactions, and data structures, while the Waterfall methodology provided a systematic development framework. Black Box Testing achieved a 100% functional success rate, indicating that the implemented functions operated according to the defined requirements.The findings indicate that FIFO can support proper stock rotation by prioritizing older inventory, while reorder point calculation can assist in identifying replenishment needs. Consequently, the proposed approach contributes to reducing recording errors, improving stock visibility, accelerating reporting, and supporting operational decision-making.Nevertheless, this study is limited to a single company and evaluates system performance primarily through functional testing. Quantitative improvements in inventory turnover, holding costs, stockouts, and user productivity were not measured longitudinally. Future research should evaluate these indicators through comparative or longitudinal studies and incorporate demand forecasting, safety stock optimization, and dynamic reorder point models. Multi-company evaluations are also recommended to assess the generalizability and scalability of the proposed approach.

ACKNOWLEDGEMENTS

The author would like to express sincere gratitude to all parties who contributed to the completion of this research. Special appreciation is extended to the management and staff of PT. Harmony Abadi Sejahtera for providing the opportunity, data, and support necessary to conduct this study.The author is also deeply thankful to the academic supervisors for their valuable guidance, constructive feedback, and continuous encouragement throughout the research process. Their insights and expertise greatly contributed to the successful completion of this study.Furthermore, appreciation is given to colleagues and peers who provided assistance, discussions, and moral support during the development and testing of the system. Lastly, the author gratefully acknowledges the support of family members for their patience, motivation, and encouragement throughout the research period.

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