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Design of Warehouse Management Information System (Case Study: PT Total Teknologi Rekacipta)

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ABSTRACT

This study aims to design a warehouse management information system by implementing the 5S method to address the stock checking and item arrangement disorganization at PT Total Teknologi Rekacipta. Currently, the company conducts stock recording manually, resulting in poorly arranged items, ungrouped spare parts, lengthy stock-checking processes, and frequent data duplication. The 5S method (Seiri, Seiton, Seiso, Seiketsu, and Shitsuke) is applied to organize the warehouse area, supported by developing a web-based inventory information system using the Waterfall methodology. The system is developed using PHP and MySQL, featuring data input, storage location tracking, and photo documentation. Black box testing results show that all functional system requirements are met. This system enhances stock management efficiency and accelerates company decision-making processes. The implementation reduced stock checking time from 1–2 days to less than 1 minute and eliminated data duplication. While 5S and web-based inventory are well-known approaches, this study contributes a practical implementation model by combining warehouse organization through 5S as a preparatory step before digitalization. This stepwise approach can serve as a reference for small and medium enterprises seeking to improve their physical warehouse management and digital stock control practices.

Keywords
5S, Efficiency, Information System, Warehouse Management, Waterfall

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INTRODUCTION

PT Total Teknologi Rekacipta is a company engaged in information technology, particularly in the service and sales of security systems such as CCTV devices, fingerprint attendance, and other supporting components. The company serves projects from the government, private, and individuals and has begun developing a retail-based sales system. However, in managing goods in the warehouse, the company still faces several problems that hamper operational effectiveness. Information systems are an important element supporting the company's operations [1]. Information systems can improve the efficiency of organizational operations, accelerate access to information, and improve decision-making accuracy [2]. This system is essential in inventory management because it reduces human error and speeds up data recording [3]. However, this company does not yet have an information system to handle recording company goods. While similar studies have applied inventory systems in various industries, limited research has combined the 5S method with web-based systems tailored explicitly for small-scale technology service providers like PT Total Teknologi Rekacipta. This research aims to fill this gap by designing an integrated solution.

Recording data on goods is still manual; goods are stored without a clear arrangement, are not grouped, and there is no digital stock checking system. Based on observations, the stock-checking process takes approximately 12–16 hours (spread across 1–2 working days), with an average of 15–20 duplicated entries and 10–12 misplaced items recorded monthly. These issues often result in delayed order fulfillment, increased warehouse staff workload, and difficulty identifying item availability during urgent projects. This highlights the urgent need for an integrated and accurate system. Along with technology development, activities still carried out manually should be able to switch to a computational system to speed up the work process [4].

Before implementing a digital inventory system, it is essential to address the foundational aspects of warehouse management—namely, the organization and condition of the physical workspace [5]. An effective method for optimizing the work environment is the 5S methodology, which includes Seiri (sorting), Seiton (systematic arrangement), Seiso (cleaning), Seiketsu (standardization), and Shitsuke (discipline). These principles foster a cleaner, more organized, and more efficient workplace [6].

Although both 5S and inventory systems have been widely studied independently, there is a lack of research focusing on the use of 5S as a preparatory framework for digital transformation in warehouse management, particularly in the context of small and medium-sized technology service enterprises. This study seeks to bridge that gap by proposing a combined approach: first, implementing the 5S methodology to restructure the warehouse environment, followed by the development of a web-based inventory system tailored to the operational needs of SMEs like PT Total Teknologi Rekacipta.

Information Systems

Information systems are interconnected components, including technology and human activities, which collect, process, store, and distribute information [7]. The goal is to support decision-making, coordination, analysis, and generate useful information for the organization. Management Information System (MIS) is a system that helps organizations manage operations, make decisions, and gain a competitive advantage through the process of collecting, processing, storing, and distributing technology-based information [8]. Modern information systems are the backbone of company operations, enabling process automation and increased efficiency [9].

Unified Modeling Language

Unified Modeling Language (UML) is a language that is visualized through images or diagrams in software development. UML is useful for providing descriptions and specifications in developing and documenting object-oriented systems [10]. Unified Modeling Language (UML) is a standard modeling language used to describe, design, build, and document software systems. UML provides a comprehensive system architecture model, especially in developing object-oriented systems [11].

Waterfall Method

The Waterfall model is one of the oldest and most structured software development methodologies applied in information technology because this method divides the software development process into several sequential stages [12]. Although many new software development methods have emerged, the Waterfall model is still widely used in projects with a fixed scope and unchanging needs [13]. This approach offers a systematic structure and strong documentation at each project stage [14]. Although agile approaches are multiplying, the Waterfall model is still the choice in projects with stable and documented requirements [15].

5S method

The 5S methodology was first discovered by Takashi Osada in 1980, which aims to create and maintain a quality work environment in an organization or company [16]. The 5S method was also introduced by Hiroyuki Hirano (1996), which aims to organize and standardize the work area through five main principles, namely: Seiri (sorting), Seiton (arrangement), Seiso (cleaning), Seiketsu (standardization), and Shitsuke (discipline) [17]. This method creates a clean, efficient, and disciplined work environment that supports increased productivity and work quality [18]. 5S is a highly effective method for improving productivity, safety, and quality in a warehouse environment. Organizations implementing 5S thoroughly can reduce the search time for goods and increase work efficiency [19].

METHOD

This study used the 5S methodology (Seiri, Seiton, Seiso, Seiketsu, and Shitsuke) to organize the company's warehouse and utilizes the waterfall model for information system development. The development stages encompass needs analysis and system design utilizing Unified Modeling Language (UML) diagrams, including Use Case Diagrams (to delineate system functionality and user interaction), Activity Diagrams (to depict the flow of activities within the system), and Entity Relationship Diagrams (ERD) (to represent data structures and relationships). The system is created utilizing the PHP programming language, a prevalent server-side scripting language for web creation, alongside the MySQL database. This open-source relational database management system organizes and administers structured data. System testing is performed via the black box methodology, which emphasizes input-output behavior while disregarding internal code logic. The interview engaged the owner in obtaining insights into everyday operations and issues. Observations were performed for a week to document regular activities and warehouse conditions. Data is acquired by interviews, direct observation, and corporate documents. Figure 1 and 2 depict illustrations of the 5S approach and the waterfall method, respectively.

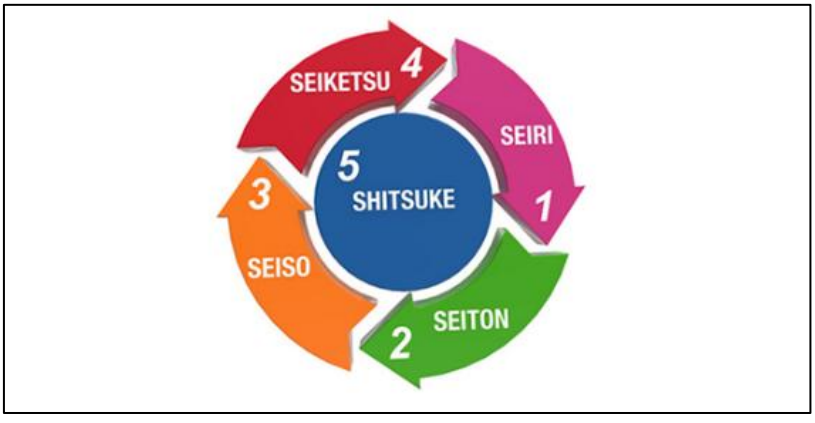

Figure 1. The 5S Method

The Waterfall model was selected for its suitability for projects with clearly defined and stable requirements, allowing for systematic development and thorough documentation. Observational and interview data were validated through triangulation between staff roles to ensure consistency in identifying warehouse challenges.

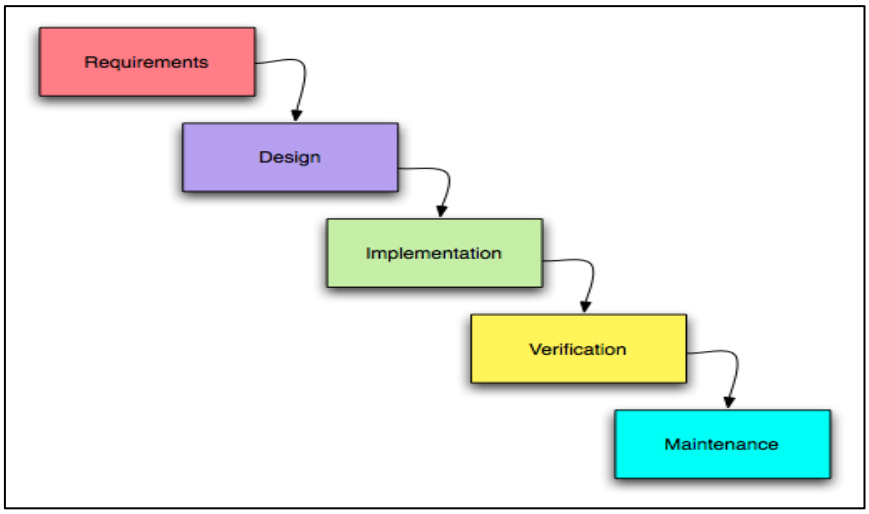

Figure 2. The Waterfall Method

The stages or process of this research flow are described as a flowchart, which can be seen in Figure 3.

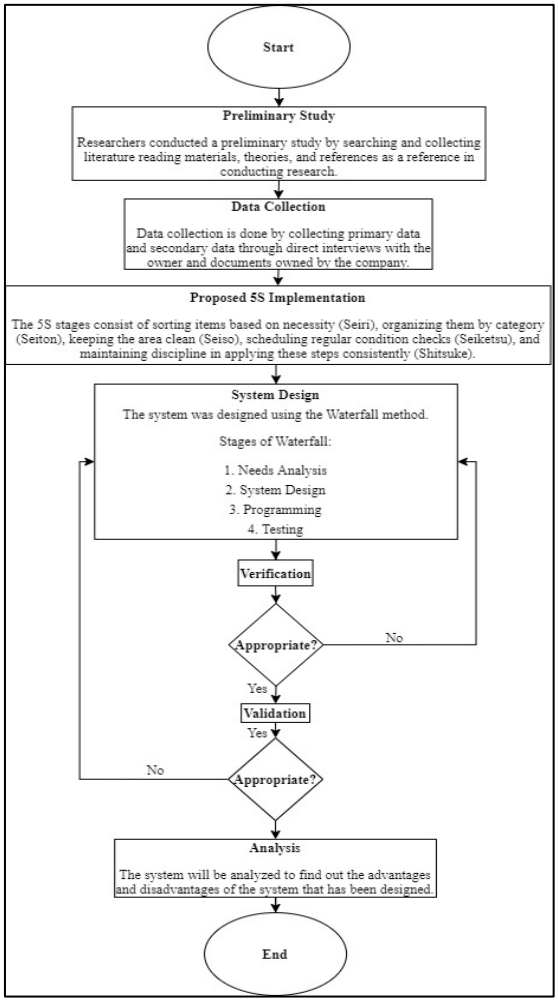

Figure 3. Research Flowchart

RESULT AND DISCUSSION

Proposed 5S Method

Before designing a warehouse management information system, it is essential to solve the main problems in warehouse management at PT Total Teknologi Rekacipta, such as the unorganized condition of the warehouse, scattered goods without clear categories, and the lack of a disciplined work culture in returning equipment. These problems can be addressed by applying the 5S method (Seiri, Seiton, Seiso, Seiketsu, and Shitsuke), which is relevant to the lean concept in industrial engineering.

The implementation of 5S at PT Total Teknologi Rekacipta showed measurable improvements. During Seiri, approximately 27.3% of unused or obsolete items were identified and removed from the warehouse. In the Seiton phase, a shelf coding system was introduced, reducing item retrieval time from an average of 15–20 minutes to just 5 minutes. Through Seiso, scheduled cleaning was implemented for the first time, with monthly cleaning introduced to reduce dust accumulation and improve working conditions. Seiketsu was implemented by developing visual SOPs and standardized labels, which led to consistent item placement and adherence to cleaning protocols. Lastly, Shitsuke will involve staff training and routine audits, with the goal of reaching a 90% compliance rate with established procedures within three months.

This method helped categorize goods, arrange storage space, and form a more disciplined work culture, thus facilitating the integration of a more efficient and accurate information system. Therefore, implementing 5S is an essential first step before designing a warehouse management information system in the company. The following provides further details on the implementation and outcomes of each 5S stage.

Seiri (Summarize)

This stage involves sorting the necessary elements and eliminating the unnecessary elements in the workplace. Elements in the workplace are related to work and need to be made more concise. The proposed Red Tag can be seen in Figure 4. Before implementation, the warehouse stored approximately 410 items without clear classification or selection. Through the Seiri stage, a red tagging process was applied, and around 112 items (27.3%) were identified as obsolete, damaged, or irrelevant to the company's operational needs. These items were subsequently removed from the warehouse. As a result, the number of stored items was reduced to 298 essential items, significantly minimizing clutter and making the stock-checking process faster and more efficient.

Figure 4. Red Tag

Seiton (Neat)

Items identified using the red tag must be returned or positioned in their proper place. Items that have been identified will be moved and positioned in their respective categories by making shelves based on the type of item. The shelf code is made with an alphanumeric code system as a marker for the storage location of goods, which can be seen in Figure 5.

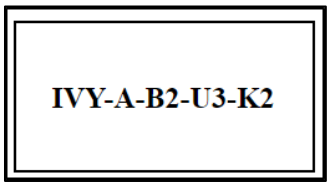

Figure 5. Alphanumeric Code

Figure 5 is interpreted as "inventory goods, on cupboard shelf A, on the 2nd shelf row, 3rd order from the left, and 2nd column". The numbering is arranged from left to right to follow the habit of the direction of the eyes that read it. If, in a row, the goods are arranged in levels, then the numbering becomes "IVY-A-B1-U3-K2-T2". If interpreted, it means "inventory goods, on cupboard shelf A, on the 1st shelf row, 3rd order from the left, 2nd column, and 2nd stack". Previously unorganized items now have designated storage locations. This significantly reduced item retrieval time from 15–20 minutes to only 5 minutes, improving operational efficiency.

Seiso (Clean)

The stored goods must be kept clean to maintain their quality. The seiso stage is carried out by scheduling regular warehouse cleaning activities to reduce dust and keep the goods clean. Seiso ensured a clean working environment by implementing routine cleaning schedules.

Figure 6. Dusty and Clean Warehouse

Before 5S, the warehouse was dusty and uncomfortable; Figure 6 shows the condition of the storage area before and after cleaning. After seiso, cleanliness improved, and the condition of stored items and supporting visual order within the workspace was maintained. Considering the infrequent warehouse activity and the company's project-based operations, monthly cleaning is deemed sufficient to ensure cleanliness and comfort when checking goods. The regular cleaning schedule improves the cleanliness of the warehouse, as observed through visual inspection.

Seiketsu (Care)

After the goods are stored in place and cleaning activities have been carried out, the process of storing goods will begin to be carried out based on the SOP (Standard Operating Procedure) that is shown in Figure 7. The SOP that is prepared is useful so that workers continue to comply with and undergo the previous 3S that have been carried out, namely seiri, seiton, and seiso. In addition, the 5S concept should also be socialized to workers so that the procedures that have been prepared can be implemented consistently. Standard procedures and visual guidelines were developed to ensure consistency in maintaining the first three S's. These standards, such as the labeling system and storage instructions, are now consistently followed, preventing the workspace from reverting to its previous disorganized state. Standard operating procedures and visual labeling were applied to 100% of storage locations, supporting consistency in operations.

	STANDARD OPERATING PROCEDURE	Doc Code.	
		No. Revision	
	SEIRI, SEITON, SEISO, SEIKETSU, SHITSUKE (5S)	Page	
		Effective Date	

A. OBJECTIVE:

The implementation procedure for 55 seiri seiton seiso seiketsu shitsuke is compiled as a definite and clear guideline to ensure that the 5S culture runs according to standard operating procedures.

B. SCOPE:

1. The implementation of 5S seiri seiton seiso seiketsu shitsuke is carried out by all workers with discipline and consistency.
2. The implementation of 55 seiri seiton seiso seiketsu shitsuke is carried out by all members of the company.
3. PIC in a work unit, part of a work unit or a specific system ensures that the SS runs according to SOP
4. The company owner carries out periodic evaluation and monitoring to ensure that 55 is running according to SOP.
5. If there is a deviation in the implementation of 5S, the owner can give a reprimand, recommendation and/or warning to the party who deviates from the implementation of 5S.
6. The results of the implementation of 5S must be documented and the results shown so that they can be an evaluation for the company in the future.
7. The 5S work culture is ensured to run with high commitment, discipline, and become the company's work culture.
8. Ensure the implementation of the 55 culture in a planned and systematic manner

Figure 7. Standard Operating Procedure

Shitsuke (Diligent)

The last stage is shitsuke (diligent). This stage of habituation or discipline is carried out by providing employees with training regarding applying the 5S method in warehouse management. Monitoring and evaluation also need to be done regularly to ensure that the culture that has been implemented continues to run well, as well as establishing routine audits that are useful to ensure that the sustainability of the 5S method that has been in the company can take place routinely. The final stage focused on fostering a culture of discipline through training, regular evaluations, and 5S audit forms. Workers became more consistent and responsible in maintaining cleanliness and order. This positively impacted data accuracy, minimized human errors, and ensured real-time inventory updates. Shitsuke is planned to involve staff training and routine audits, which are expected to achieve a compliance rate of around 90% with the established procedures within three months of implementation.

After the 5S concept is successfully applied to the warehouse, the process of recording goods will be more straightforward by implementing a warehouse management information system. The following is a proposed evaluation form for implementing routine audits to monitor the sustainability of 5S, which can be seen in Figure 8.

5S Procedure Form Patrol					No. Document	
					Date	
Location:					Revision	
					Date of Revision	

0	1	2	3	4
Haven't started 5S activities, no effort at all	Already started 5S activities, but there are many major improvements (improvements need several days)	Pretty good, just needs some minor fixes (can be fixed right away)	It's good, just needs a little improvement	It's very good, please continue to maintain this condition.

5S	No		Description	(0-4)	
STEP 1: Seiri			The activity of sorting and throwing away unnecessary items		Notes
	1				
	2				
	3				
	4				
	5				
			SCORE	0	
STEP 2: Seiton			The activity of tidying up all the items		Notes
	1				
	2				
	3				
	4				
	5				
			SCORE	0	
STEP 3: Seiso			Routine cleaning of warehouses, technician rooms and work environments		Notes
	1				
	2				
	3				
	4				
	5				
			SCORE	0	
STEP 4: Seiketsu			Activities of caring for or maintaining seiri, seiton, and seiso activities		Notes
	1				
	2				
	3				
	4				
	5				
			SCORE	0	
STEP 5: Shitsuke			Habitual activities and maintenance of the 5S program that is already running		Notes
	1				
	2				
	3				
	4				
	5				
			SCORE	0	
			TOTAL SCORE	0	

Figure 8. 5S Evaluation Form

System Requirements Identification

System requirements identification is carried out to identify all aspects needed in the design of the system to be built. Identification of system needs is carried out by evaluating the current system, which helps reveal some of the deficiencies that need to be corrected so that it is necessary to design an information system that can facilitate the process of checking the stock of goods and being able to monitor the application of the 5S method that has been designed to overcome these problems.

System Design

System design is done by compiling several diagrams that illustrate the web design to be designed. This diagram is based on system analysis results, which help determine web design needs. Some of the diagrams compiled include use case diagrams, activity diagrams, and entity relationship diagrams.

Implementation

Creating a warehouse management information system for PT Total Teknologi Rekacipta involved designing a database with the help of a database management system, namely MySQL, and its implementation using the PHP programming language for the designed web display.

Testing

System testing is carried out to ensure that the information system design can run according to the company's functional needs. In this study, testing was carried out using the Black Box method. Black Box is a software testing method that focuses on system functions without examining the internal structure of the program code.

Business Process

Business processes highlight the primary workflow of the organization. PT Total Teknologi Rekacipta's business process flow encompasses several activities, including project tenders, purchase of stock items, inspection, and installation at the client's site. The business process at PT Total Teknologi Rekacipta commences when a customer submits a project proposal to the organization. The proposal is subsequently succeeded by an internal project bidding procedure executed by the company's technical staff. Upon project approval, the warehouse personnel verify product availability. The administrator authenticates and corroborates the data to ensure precision, contingent upon the availability of the requisite components. The technical team concurrently negotiates pricing with the client. Upon reaching an agreement, the customer proceeds to remit a down payment as confirmation of the transaction. If the agreement is not reached, the project will be terminated.

Upon receipt of payment, the administrator documents the project's material requirements, generating order data. A decision point ensues: an order is issued to the distributor if products require procurement. The distributor fulfills the order by packing and shipping the products to PT Total Teknologi Rekacipta. Upon receipt of the materials, the administrator organizes technical equipment, designates technicians, and coordinates the team's deployment to the project site. The concluding phase in this process involves the installation of equipment at the client's location. This workflow demonstrates the collaborative engagement of several roles, including clients, warehouse personnel, administrators, technicians, and distributors, guaranteeing a systematic and traceable procedure from project concept to execution.

Use Case Diagram

Use case diagrams to represent the functionality of a system and describe the interaction between actors and the system. In use cases, some actors describe human and system entities that interact or perform tasks in the system. The use case diagram of PT Total Teknologi Rekacipta can be seen in Figure 9.

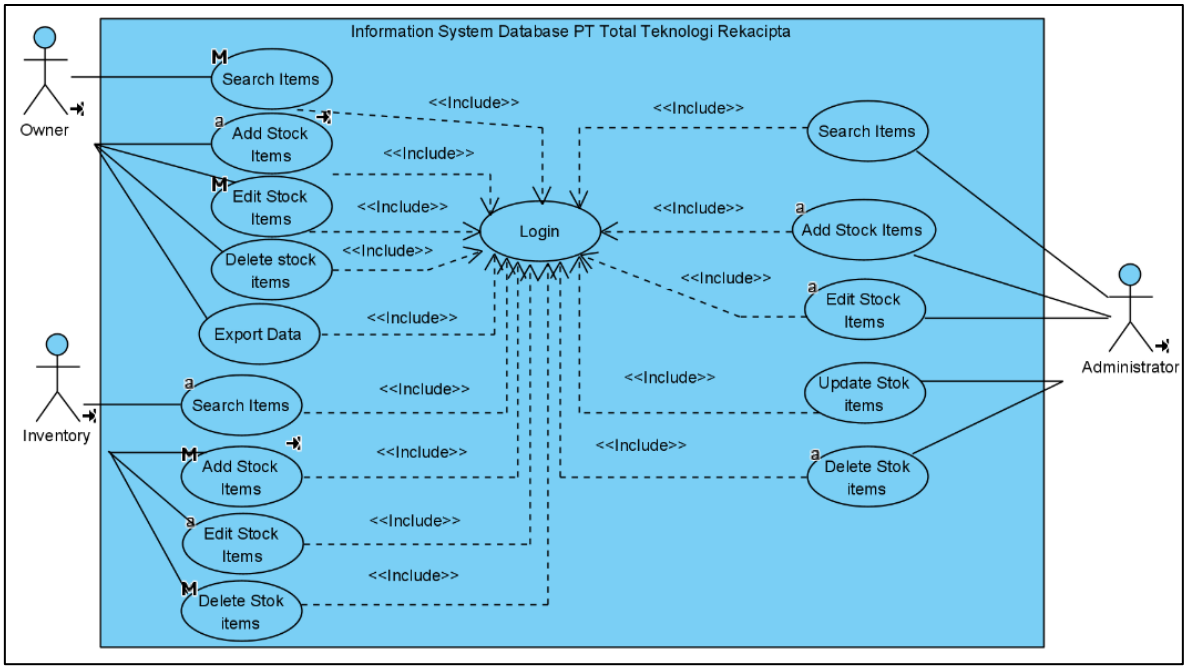

Figure 9. Use Case Diagram

Activity Diagram

An activity diagram will visualize the sequence of activities from the use case that has been designed and display the input that will be performed and the resulting output. PT Total Teknologi Rekacipta has four activity diagrams, one user login activity diagram, and three actor activity diagrams. Activity diagram actors have the same activities. The PT Total Teknologi Rekacipta activity diagram can be seen in Figures 10 and 11.

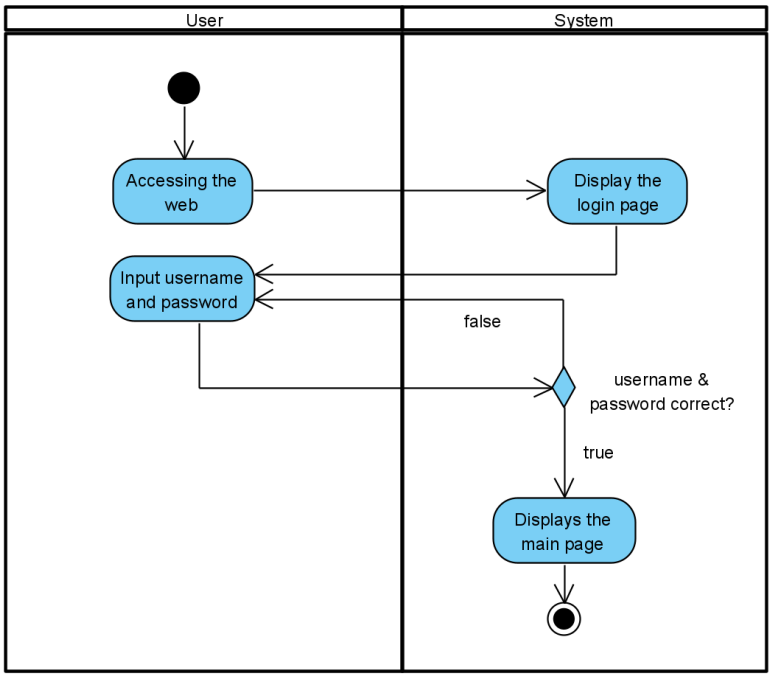

Figure 10. Activity Diagram of User Login

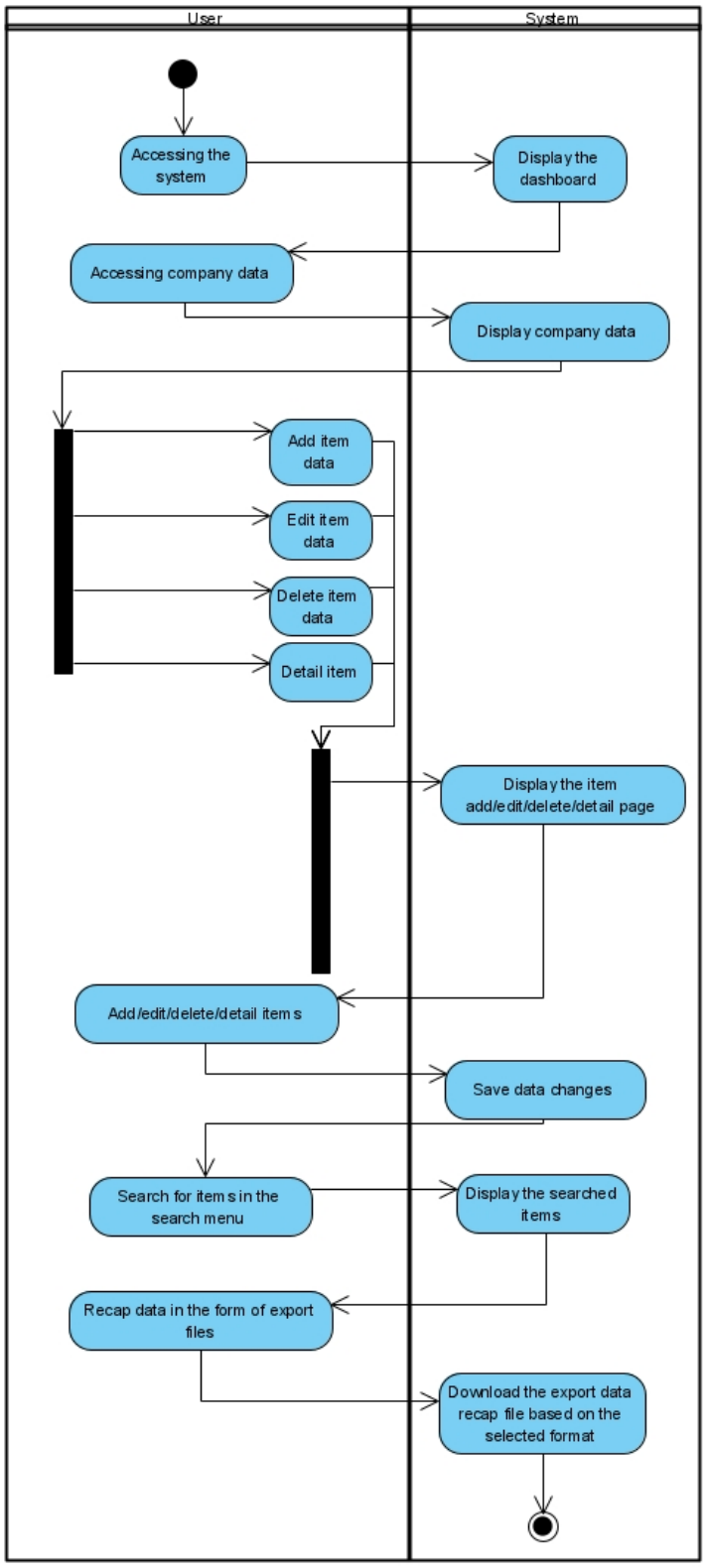

Figure 11. User Activity Diagram

Entity Relationship Diagram

ERD is useful for representing data types and logical relationships between entities in a systematic and structured manner. The relationship between entities is determined through primary key and foreign key attributes. The ERD of PT Total Teknologi Rekacipta can be seen in Figure 12.

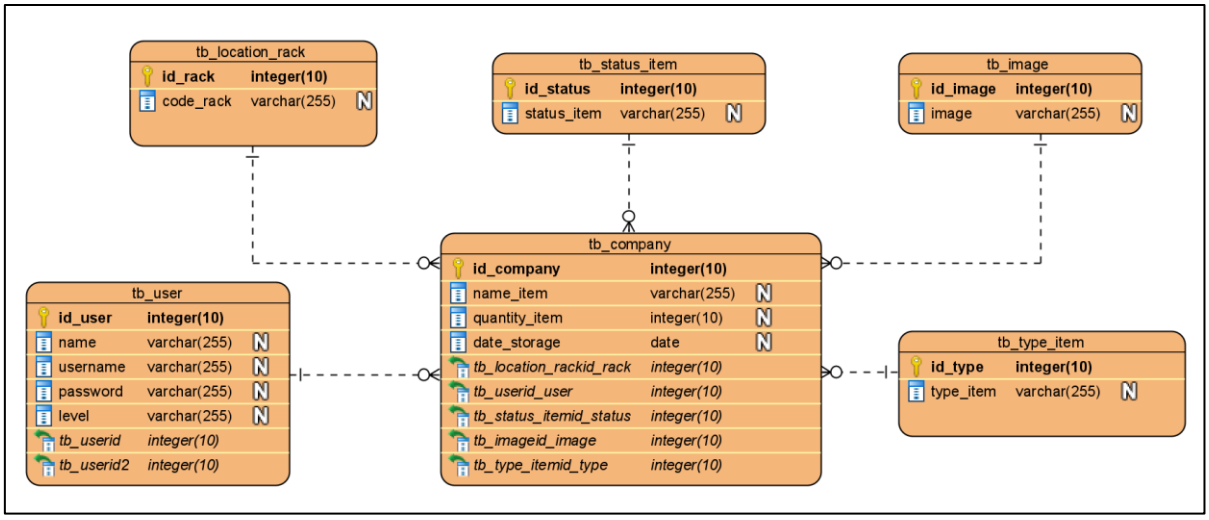

Figure 12. Entity Relationship Diagram

Results of System Implementation

The results of this research are in the form of a proposal for applying the 5S method in the warehouse and are supported by a warehouse management information system that helps increase the efficiency of checking stock data to improve decision-making at PT Total Teknologi Rekacipta.

The implementation of web development is based on a conceptual model that has been developed before. Making a warehouse management web company, PT Total Teknologi Rekacipta, is done by designing a database with the help of a database management system, namely MySQL, and its implementation using the PHP programming language for the designed web display.

1. Login

   The web use begins with the user typing in the localhost domain; then, the system displays the first page, namely the login page. Users can log in using the username and password provided previously. The login page can be seen in Figure 13.

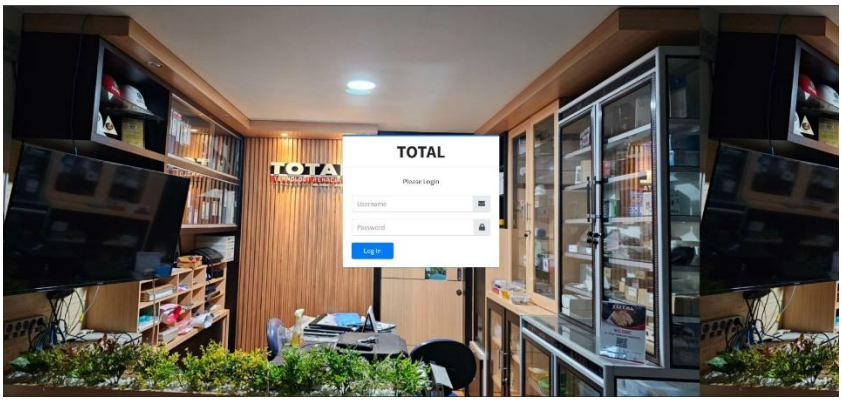

Figure 13. Login

2. Dashboard

   After the user has successfully logged in, they will be directed to the dashboard page. Users can find the status of new and used items on the dashboard page. The dashboard page can be seen in Figure 14.

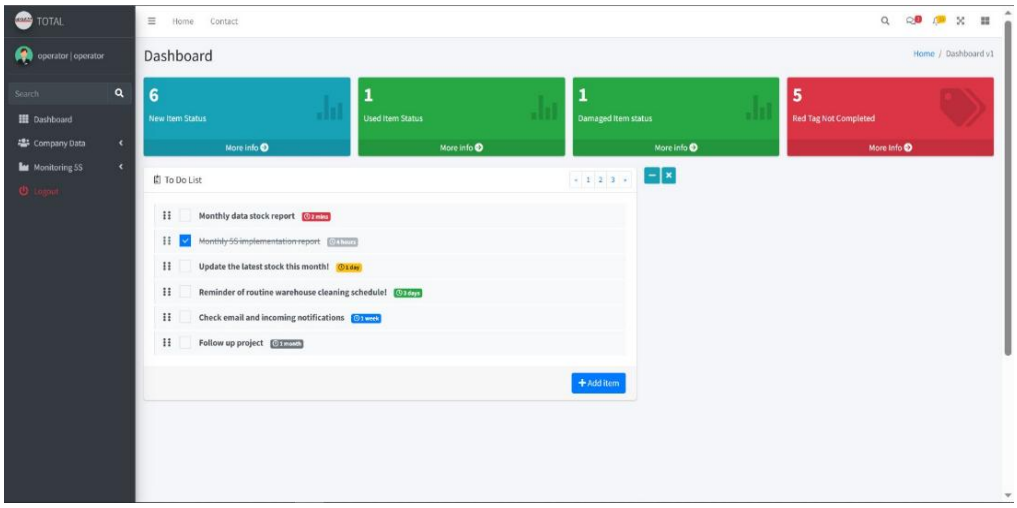

Figure 14. Dashboard

3. Company Data

The left side of the page has a sidebar with options, one of which is stock data. When clicked, it will be directed to the PT Total Teknologi Rekacipta stock data page. The company data page can be seen in Figure 15.

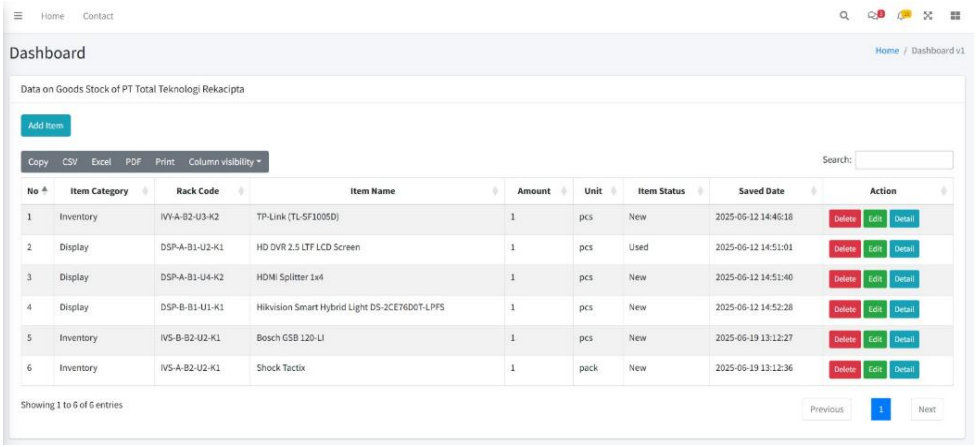

Figure 15. Compay Data Page

4. Add Data Feature

There is an add data feature that functions to add company stock data. Users are asked to enter the required data, such as item type, shelf code, item name, item quantity, item status, and the date the item data was inputted. The add data page can be seen in Figure 16.

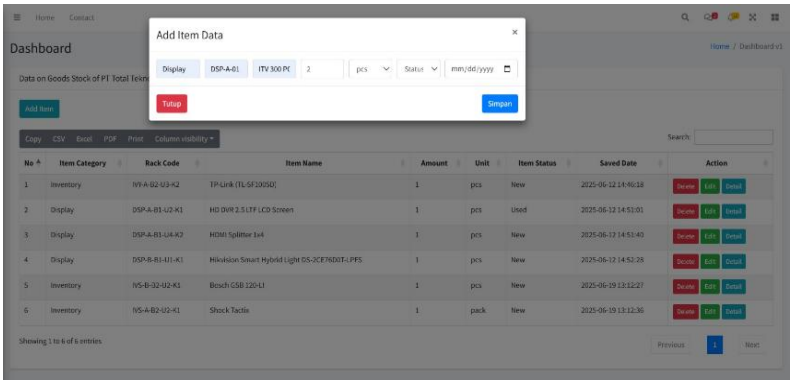

Figure 16. Add Data Page

5. Edit, Delete, Detail Feature

   Data that has been inputted can be edited using the edit data feature. Data can be edited, and users can also input photos of the location of the stored goods, but this is optional. Data that already exists in the system can also be deleted via the delete data feature. In addition, images of the location of the goods can be seen in the detail feature.

Based on the problems that occurred, the researcher proposed the application of the 5S method, namely Seiri (sorting), Seiton (arrangement), Seiso (cleaning), Seiketsu (standardization), and Shitsuke (habituation) as a basis for forming a more structured work culture in the warehouse area. The application of this method is then supported by designing a web-based warehouse management information system using the Waterfall software development approach.

In the system design process, various diagrams based on the Unified Modeling Language (UML) are used to visually model system requirements. The diagrams used are the use case diagram, activity diagram, and Entity Relationship Diagram (ERD), all of which are designed based on the business process that has been formed. The information system that has been developed can be directly implemented with the existing system in the company environment, provided that all technical and operational requirements have been met. These requirements include three main aspects, namely hardware, software, and user skills in operating the system.

Table 1 Comparison of Warehouse Management Performance Before and After System Implementation

Aspect	Before Implementation	After Implementation
Stock Checking Time	1-2 Days	< 1 Minute
Data Duplication	Frequently Occurred	None Detected
Item Arrangement	Scattered and Unclassified	Categorized by Shelf Codes
Retrieval Time per Item	15-20 Minutes	5 Minutes
Documentation Availability	Manual Notes (Paper-based)	Digital Records with Photos

Implementing the 5S method and the warehouse management information system at PT Total Teknologi Rekacipta led to significant improvements in stock control, as summarized in Table 1. Initially done manually over 1–2 days, the checking process can now be completed in less than 1 minute and from any location by accessing the web interface to search for item status. This represents a >99% improvement in stock-checking efficiency. Data duplication previously 15–20 cases per month was eliminated, and item retrieval time improved by about 66%, from 15–20 minutes to 5 minutes per item. The structured shelf coding and categorized storage (Seiton) ensured consistent item placement, enabling easier mapping in the digital system. Documentation shifted from manual notes to digital records with photos, improving traceability and supporting remote monitoring. These results align with Walniak [20], who emphasized that 5S implementation leads to measurable gains in efficiency and data accuracy. Although this study was conducted in a service-based SME, the outcomes suggest that similar operational gains can be achieved through basic 5S adoption before digitalization. The system's technical and cultural improvements, such as the 5S method, have embedded discipline and standard practices into the warehouse routine.

Black box testing confirmed that all core functions like login, data input/edit, search, reporting, and data export (PDF, Excel, CSV) met requirements and operated without errors across all tested scenarios. This validates the system's usability, reliability, and suitability for

warehouse operations. The system facilitates fast and accurate data input, easy tracking of item storage locations, and convenient data export, even when accessed remotely. The advantages of PT Total Teknologi Rekacipta's warehouse management information system are that it allows users to check and record item data quickly and accurately through efficient data input features, facilitates tracking of item storage locations to speed up operational processes, and provides data export features in PDF, Excel, and CSV formats that are useful when users are outside the office. Its user-friendly interface also minimizes the need for specialized technical training.

In addition to technical improvements, 5S integration has developed a disciplined work culture through monthly audits and standardized procedures (Seiketsu, Shitsuke), ensuring warehouse organization, cleanliness, and sustainability. However, the system still lacks automation technologies such as barcode or QR code scanning, which could reduce typing errors and enhance data input speed. This limitation presents an opportunity for future system development, particularly to further minimize human error in data entry.

CONCLUSION AND RECOMMENDATION

Conclusion

This research concludes that the warehouse management information system was designed successfully to address the inventory management challenges at PT Total Teknologi Rekacipta. The system significantly enhances operational efficiency, demonstrated by a reduction in stock checking time from 1–2 days to less than 1 minute, elimination of data duplication (from a previous average of 15 duplicated entries per month), improved item organization through shelf coding, and faster item retrieval time (reduced from 15–20 minutes to just 5 minutes). Documentation also transitioned from paper-based notes to digital records, with photo attachments, enhancing traceability and data accuracy. The black box testing results showed that 100% of functional requirements—such as login, data input/edit, and search functionalities—operated as expected across all tested scenarios, confirming system validity and usability. Increased efficiency directly impacts productivity, as the time previously consumed by manual inventory checks can now be allocated to more productive activities such as installation planning or customer support. Furthermore, this study provides a replicable framework for SMEs transitioning from manual to digital inventory systems. Integrating the 5S method as an initial step ensures that the digital system operates effectively and aligns with an organized, clean, and structured physical environment, thus improving sustainability and usability.

Recommendation

Suggestions for future research include deeper integration of the 5S process into the inventory management information system to enable real-time monitoring of 5S implementation. Additionally, scanning technologies such as barcode or QR code systems are recommended to streamline data entry processes further and reduce human error. This research is limited by its focus on a single SME with relatively simple inventory types and a small operational team. Future studies could explore applying this integrated system in multi-location warehouses or leveraging IoT-based technologies to support real-time inventory control and continuous 5S compliance monitoring.

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