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Design Of an Appsheet-Based Inventory Management System Using the RAD Method

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ABSTRACT

Competition in the manufacturing industry requires companies to improve operational effectiveness, particularly in inventory management. PT XYZ, which initially operated in the metal fabrication services sector, has expanded into manufacturing; however, during this transition, inventory was still recorded manually, leading to data discrepancies and operational issues. Observations from a stocktaking process conducted in June 2025 indicated that inventory accuracy was only 76%, resulting in delivery delays, inventory accumulation, and potential financial losses. This study aims to design and implement an AppSheet-based inventory management system to address these problems. The system was developed using the SDLC method with RAD approach, emphasizing rapid development and user involvement. The developed system includes features for recording incoming goods, outgoing goods, production output, and real-time stock monitoring. System functionality was verified through black-box testing, while system acceptance was evaluated using User Acceptance Testing and a user satisfaction survey. The results indicate that all system functions operated as expected and met user requirements, achieving an average user satisfaction score of 4,25. Although the evaluation of long-term improvements in inventory accuracy remains limited, the system is considered reliable and suitable for daily operational use. It is expected to improve the consistency of inventory data.

Keywords: *Inventory Management System, AppSheet, RAD*

Introduction

Competition in the manufacturing industry is pushing the companies to improve the effectiveness of their operational activities. To remain competitive, companies must outplay in operations, including inventory management. [1]. Proper inventory management is a key factor in achieving strong operational and financial performance in the industry, as it significantly impacts supply chains and corporate profitability. [2]. Poor inventory management can lead to excess or insufficient stock, which indirectly affects overall company performance. [3]. Data inaccuracy is a common problem in inventory management that can cause severe operational disruptions and lead to investment decision errors, potentially threatening a company’s long-term sustainability. [4].

PT XYZ initially operated as a metal fabrication company. The production process was customized according to customer requirements, with all materials sourced and ordered by the customers. PT XYZ was responsible only for the fabrication processes, which included cutting, pressing, welding, assembly, and painting. As the company grew, PT XYZ began undertaking manufacturing activities independently, with all processes—from raw material procurement and production planning to manufacturing and finishing—under the company's complete control. Products manufactured independently by PT XYZ are referred to as SBJ products. Currently, there are 59 items classified under the SBJ product category, consisting of 7 types of raw materials, 9 types of supporting components, and 43 finished goods.

Based on observations conducted at PT XYZ, it was found that the management and recording of SBJ products are still carried out manually. Records of production results, raw material arrivals, product deliveries, and stock levels are all manually documented in a notebook. On the other hand, inventory recording plays a crucial role in maintaining data accuracy and regulating the flow of goods in and out of the warehouse [5]. The observations revealed that the existing manual stock recording system frequently results in errors, including illegible handwriting, discrepancies in recorded data, and a high risk of records being damaged or lost. Manually recorded data are also challenging to revise when adjustments are required due to errors. Furthermore, manual stock recording results in inventory information that cannot be accessed quickly or accurately, thereby hindering decision-making for inventory management and production planning. Other research conducted by Wynn [6] also indicates that manual inventory recording is highly prone to errors, leading to inaccuracies in inventory quantities and mistakes in production components. In addition to the previously described issues arising from manual inventory recording, there is another critical problem: discrepancies between recorded stock and the actual physical stock. The following section presents the stocktake data for June 2025.

Table 1. June 2025 Stocktake Data

Product Type	Recorded Stock	Physical Quantity	Discrepancy	Accuracy (%)
Raw Material	1.630	1.185	445	72
Finish Good	23.624	20.443	3.181	86
Supporting Components	38.165	26.922	11.243	70

Table 1 shows that inventory discrepancies occurred across all product categories during the June 2025 stocktake. The Supporting Component recorded the lowest inventory accuracy at 70%, indicating significant discrepancies between recorded and physical quantities. Finished goods achieved the highest accuracy at 86%, while Raw materials recorded 72%. Overall, the average inventory accuracy across all product categories was approximately 76%. These stock discrepancies have led to several operational problems, particularly in order fulfillment and logistics activities. Based on internal operational records, delivery delays occurred approximately once or twice per week, primarily due to situations in which products were recorded as available in the system. At the same time, the corresponding physical stock was unavailable. The findings are in line with the theory previously presented regarding poor inventory management. [3]. In addition, discrepancies between physical inventory and system records resulted in the accumulation of unrecorded goods, indicating inefficiencies in inventory control. Although precise financial loss figures were not available, these recurring operational disruptions demonstrate the substantial impact of inventory inaccuracies on company performance. Excess inventory leads to unnecessary inventory holding costs, while inventory shortages can result in delivery delays that negatively affect customer satisfaction. [4]. From the existing problems it shows that, manual recording practices currently applied at PT XYZ are no longer sufficient to support increasing operational complexity and accuracy requirements.

Several previous studies have addressed inventory management problems through digital information systems to improve accuracy and operational efficiency in various organizational contexts. A survey conducted by Herawati [7] at Dermaga Baut Mandiri Store developed an AppSheet-based inventory application using the prototype method to address manual recording issues, with results showing faster stock recording, minimum stock notifications, and real-time inventory reporting. Similarly, Mubarokan and Nisa [8] designed a digital inventory system for MSME Parabot Barokahin using AppSheet integrated with Google Sheets based on observation and interview methods, demonstrating a simple and user-friendly system for non-technical users that effectively reduced data errors and data loss. In a larger industrial context, Rosliana and Jaga [9] developed an AppSheet-based inventory management system at PT Unilever Indonesia Tbk using a descriptive method and Blackbox testing, which improved the efficiency and accuracy of digital inventory data management.

Overall, previous studies confirm that digital inventory management systems improve inventory data accuracy and operational efficiency. However, existing research primarily focuses on established manufacturing environments or MSMEs with relatively low process complexity. Limited attention has been given to companies transitioning from service-based to manufacturing operations, where inventory complexity and operational demands increase significantly. This research gap is particularly relevant in the case of PT XYZ, which is currently undergoing such a transition.

To address this research gap and the practical inventory management challenges faced by PT XYZ, a digital inventory recording system that can be used in real time by logistics operators in the field is required. Therefore, an AppSheet-based Inventory Management System is proposed as a solution to the problems that occurred at PT XYZ. AppSheet is a no-code application development platform that enables users to create applications without complex programming and supports integration with various platforms such as spreadsheets, Google Drive, Dropbox, and Office 365, AppSheet can also accessed through multiple devices, including mobile phones, tablets, and web browsers on PCs, allowing flexible and real-time inventory data input [10]. Considering its flexibility, ease of development, and low maintenance requirements, AppSheet was selected as the platform for developing the Inventory Management System at PT XYZ.

Research Methods

The research was conducted using the System Development Life Cycle (SDLC) approach through the Rapid Application Development (RAD) method. RAD is an application development methodology that emphasizes short and rapid development cycles, in which a system can be completed within 30–90 days [11]. RAD operates iteratively, with the system model defined at the outset according to user requirements, and during the development process, certain features may be removed or adjusted based on the results of implementation [12]. The RAD method is relatively easy to apply because the development stages are carried out concurrently within a relatively short timeframe. [13]. RAD was selected in this study because it supports fast system development through iterative system design and continuous user involvement, which is suitable for inventory systems developed using AppSheet

This study focuses on developing an AppSheet-based inventory management system for a single inventory location at PT XYZ. The scope of the system is limited to SBJ products and is intended exclusively for use by logistics staff, consisting of four users including one logistics administrator. The system supports inventory recording activities such as stock-in, stock-out, production output recording and stock control. In developing a system using the RAD method, several stages must be undertaken. The stages of application development using the RAD method are illustrated in the following diagram:

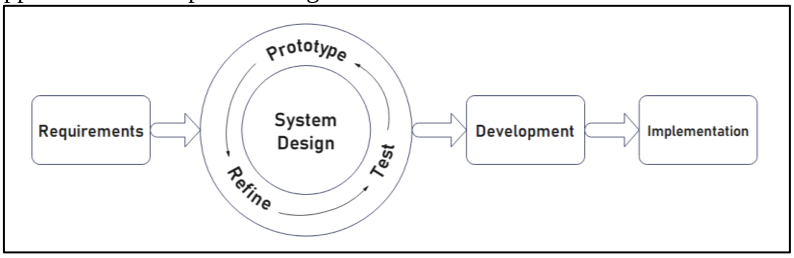

Figure 1. RAD Stages[14]

1. Requirements
   The requirements stage is the initial phase of the RAD method, aimed at identifying the overall system requirements. This stage lasted approximately one week, or until user needs were clearly identified. Data collection was conducted through interviews and direct observations with all logistics staff to obtain an overview of the existing system, the development scope, and user requirements. In accordance with the RAD approach, requirements analysis was performed concisely, with requirement validation and refinement conducted continuously throughout subsequent iterative stages.
2. System Design
   The system design stage involved developing a prototype that represents the core functionalities of the system to be built. This phase lasted approximately two weeks. During this stage, the prototype was evaluated to identify functional deficiencies, errors, and mismatches with user requirements based on user feedback. User testing was performed to reconfirm the alignment between the system design and operational needs. The prototype–refine–test cycle was carried out iteratively, with the number of iterations adjusted based on the extent of changes identified during user evaluation.
3. Development
   Based on the refined and validated prototype, the development stage focused on the complete system development, including application development and functional testing. This phase lasted approximately 4 weeks. Since the system design and core functionalities had been validated in the previous stage, the RAD development process was carried out more efficiently, with relatively few changes required during implementation.
4. Implementation
   The final stage of the RAD method was system implementation, which involved deploying the developed system for daily operational use, thereby replacing the previous manual inventory recording system. This stage lasted approximately one week. System deployment and final testing were conducted with all logistics staff involved to ensure the system operated as expected and met operational requirements.

Results and Discussion

The research results are structured according to the predefined stages of the system development method to provide a clear overview of the design, implementation, and evaluation processes of the developed inventory management system.

Requirements

At the requirements stage, the author identified the system requirements to be developed based on the results of the observations conducted. The observations revealed that inventory recording at PT XYZ is still manual, resulting in discrepancies between the records and the actual on-hand quantities. To better understand user needs for the proposed system, the author conducted direct analyses and interviews with users regarding the system to be developed, based on the company's existing workflow. The following presents the results of the user requirements identification:

Table 2. User Requirements Identification

No.	Process	Workflow	Expected System
1	Inbound (Stock-In)	1. Conduct a physical inspection of incoming goods 2. Record incoming goods according to the actual physical quantity	1. Users can input incoming goods data into the system 2. Users can modify data in case of changes or errors
2	Outbound (Stock-Out)	1. Prepare goods to be delivered according to requests 2. Record goods to be delivered based on their quantities 3. Create a delivery note	1. Users can input delivery data into the system 2. Users can modify data in case of changes or errors 3. Delivery data can be accessed to facilitate the creation of delivery notes
3	Production Output	Record production output based on reports from the production department	1. Users can input production output data into the system 2. Raw material data is automatically reduced in accordance with the recorded production output

Based on the identified problems and the results of the user requirements analysis, the developed inventory management system must include core features for recording incoming goods, outgoing goods, and production output. In addition to these core features, to support user efficiency and in line with user agreements, the system includes a feature that displays real-time stock data. All system components must be fully integrated to prevent data inconsistencies and errors.

System Design

At this stage, the author develops a conceptual prototype using the Unified Modeling Language (UML) as a system and application modeling tool. The prototype is created to represent the system under development. [15]. UML is used to describe the principal functions and workflows of the system in a structured and systematic manner [16]. This model aims to provide an initial overview of user-system interactions. The resulting conceptual prototype serves as the basis for user evaluation to ensure that the system design aligns with the requirements identified in the previous stage.

Use Case Diagram

The use case diagram illustrates the relationship between users and the system [5]. In the inventory management system to be developed, the actor or user is the logistics staff of PT XYZ. Since there is only one type of user who will interact with the system, only a single use case diagram is created. The following is the use case diagram of the developed inventory management system:

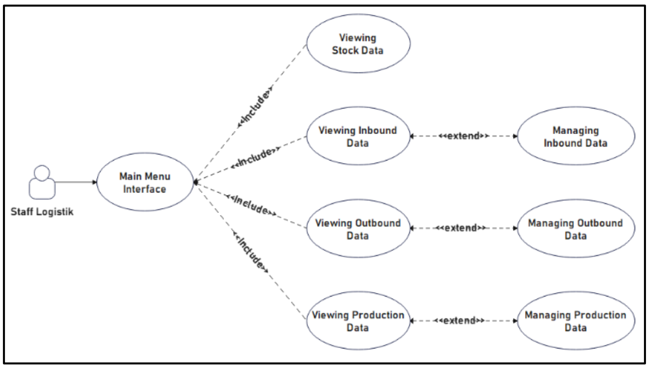

Figure 2. Use Case Diagram

Figure 2 shows the use case diagram of the system, illustrating the interaction between the inventory management system and its primary user, namely the logistics staff. All system functionalities are accessed through the Main Menu Interface. From this menu, users can view stock, inbound, outbound, and production data, enabling real-time monitoring of inventory conditions. Each viewing function is connected to a managing function through an extended relationship. Specifically, Viewing Inbound Data can be extended to Managing Inbound Data to support the recording and modification of incoming goods. Viewing Outbound Data extends to Managing Outbound Data, while Viewing Production Data extends to Managing Production Data to record inventory changes resulting from production output.

Activity Diagram

The activity diagram is created to illustrate the workflow of the developed system, including interactions between users and the system as well as data processing flows [17]. The following picture is the activity diagram of the developed inventory management system:

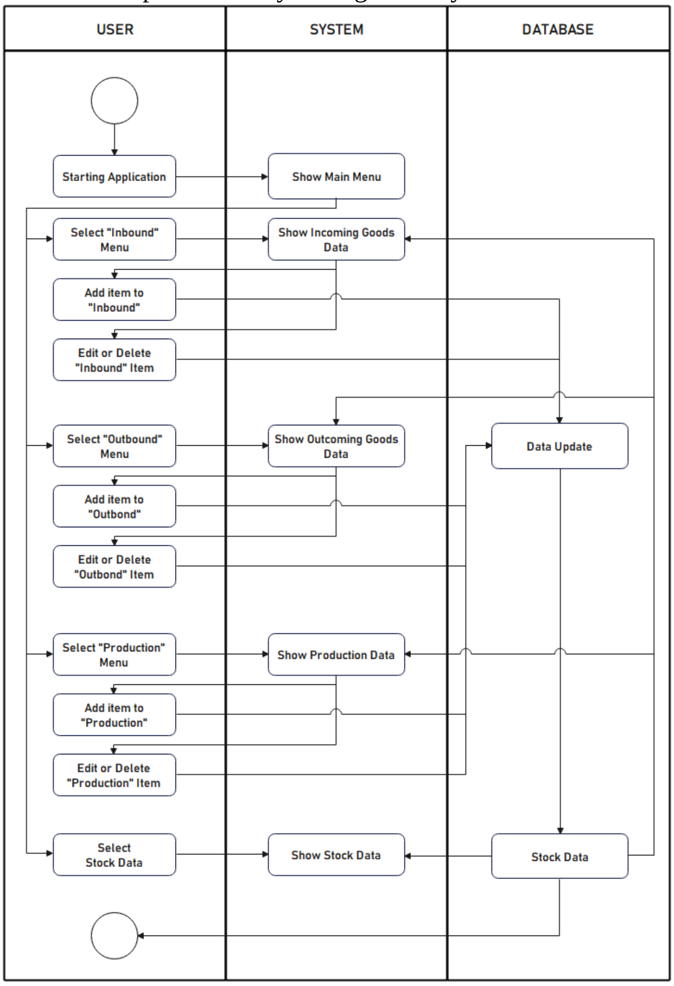

Figure 3. Activity Diagram

The activity diagram shown in Figure 3 illustrates the interaction flow among the user, the system, and the database in the inventory management system. The process begins when the user starts the application; after that, the system displays the main menu as the initial interface. From this menu, users can select several operational functions, including inbound goods recording, outbound goods recording, and production output recording. For each data entry activity, the system processes the user's request and updates the database. The diagram also depicts the process of accessing stock data, where the system retrieves inventory information from the database and presents it to the user. This activity flow demonstrates the integration between user actions, system processing, and database operations.

The next step involved refining the system design and conducting user testing. At this stage, the previously designed features, represented using UML, were validated with users to ensure alignment with operational requirements. The system design was presented to users, and feedback was collected to assess whether the proposed features met their expectations and functional needs. The results of the system design evaluation are summarized in Table 3.

Table 3. System Design Evaluation

No	System Feature	Description	User Validation
1	Stock Data Monitoring	Allow users to view stock data that is integrated with other features and updated in real time.	Suitable
2	Inbound Data Recording	Allow users to input, view, and edit inbound goods data	Suitable
3	Outbound Data Recording	Allow users to input, view, and edit outbound goods data	Suitable
4	Production Data Recording	Allow users to input, view, and edit production output data	Suitable

As shown in Table 2, which presents the results of the system design evaluation. The evaluation findings indicate that the proposed system design has met the operational needs and expectations of users. All core system features, including stock monitoring and the recording of inbound, outbound, and production data, were validated by logistics staff. Therefore, the application development process could proceed to the development phase in accordance with the RAD methodology, without requiring additional design iterations at this stage.

Development

The system design approved in the previous stage was implemented as a functional application during the development phase using the AppSheet platform. The development process was conducted through application configuration, including database setup using spreadsheets, feature customization, and user interface design. The system database was integrated with existing data sources and centrally used to record inbound goods, outbound goods, and production output. The following section shows the system features and interface of the developed inventory management system:

System Feature

1. Menu

   The menu feature serves as the primary navigation component, allowing users to access and select the various features available in the application.

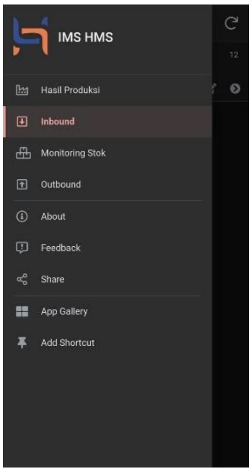

Figure 4. System Design Evaluation

2. Inbound
   The Inbound feature is used by logistics staff to record data when raw materials or supporting components are received into the inventory. This feature also provides a recap of all inbound transactions stored in the system. When incoming goods data are entered, the stock data are automatically updated and increased in real time based on the recorded quantities. This also happens if the user makes changes to the data, the data will immediately be updated in real time.

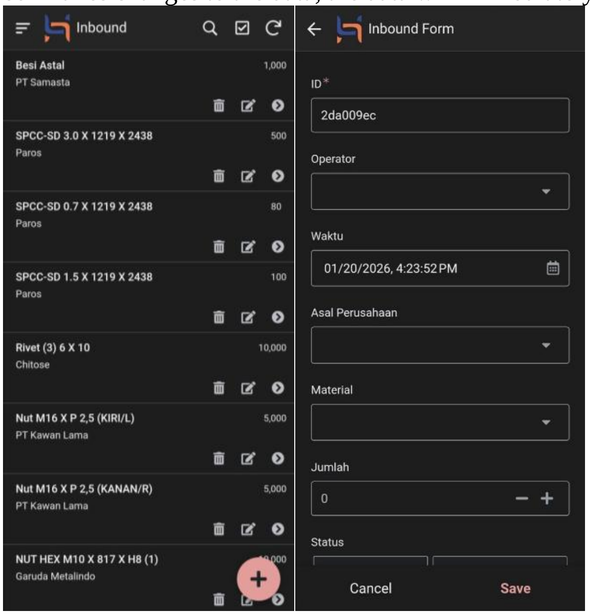

Figure 5. Incoming Goods Feature Interface

3. Outbound
   The Outbound feature allows users to view, edit, and record data when items are issued from the inventory. Each outbound entry or data modification automatically updates the corresponding stock quantities to reflect the items released.

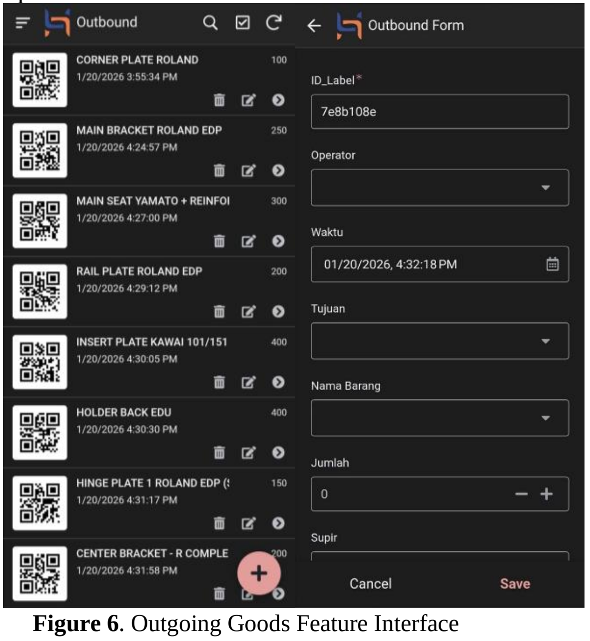

Figure 6. Outgoing Goods Feature Interface

4. Production Output
   The Production Output feature records finished goods after the production process is complete. Through this feature, finished goods quantities are added to the inventory, while the raw materials and supporting components used in the production process are automatically reduced in accordance with the recorded production output.

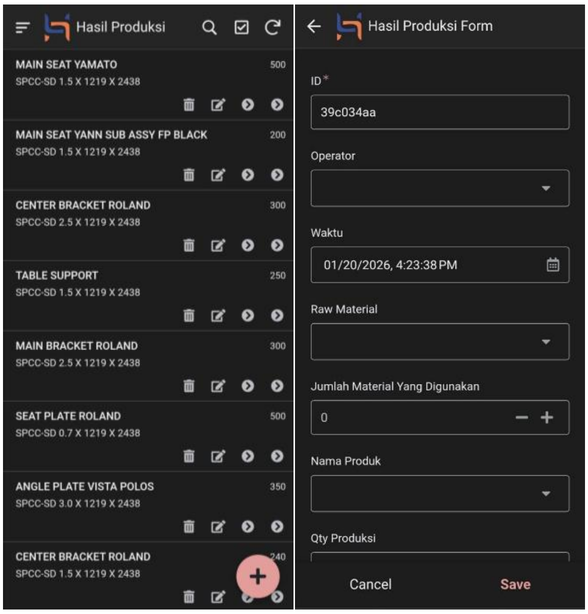

Figure 7. Production Output Feature Interface

5. Stock Data
   The Stock Data feature provides users with an overview of current inventory for all stored, release, or used items, including raw materials, finished goods, and supporting components. This feature displays inventory data that are integrated with inbound, outbound, and production records and updated in real time.

Figure 8. Stock Data Feature Interface

Testing

After the system was developed in AppSheet, black-box testing was conducted to verify that it met user requirements. Black-box testing is a functional testing approach that assesses system behavior by validating inputs and outputs without examining the internal system logic. [18]. This testing method was selected because it is suitable for no-code application development, where the primary objective is to verify that each system feature functions correctly from the user's perspective. Through black-box testing, the functionality of inventory features, including inbound, outbound, production, and stock data, was validated against the expected outcomes. Table 4 presents the results of Black-Box testing.

Table 4. Blackbox Testing Results

No.	Test Object	Test Steps	Expected Result	Actual Result	Status
1	Incoming Goods Input Feature	1. Click add incoming goods data 2. Click edit incoming goods data	1. Incoming goods data is successfully recorded in the system 2. Existing data can be successfully modified	1. Incoming goods data is successfully recorded in the system 2. Existing data can be successfully modified	Pass
2	Outgoing Goods Input Feature	1. Click add outgoing goods data 2. Click edit outgoing goods data	1. Outgoing goods data is successfully recorded in the system 2. Existing data can be successfully modified	1. Outgoing goods data is successfully recorded in the system 2. Existing data can be successfully modified	Pass
3	Production Output Feature	1. Click add production output data 2. Click edit production output data	1. Production output data is successfully recorded in the system 2. Existing data can be successfully modified	1. Production output data is successfully recorded in the system 2. Existing data can be successfully modified	Pass
4	Stock Data Feature	Access stock data feature	1. Overall stock data is successfully displayed 2. Data entered or modified in other features correctly updates stock data	1. Overall stock data is successfully displayed 2. Data entered or modified in other features correctly updates stock data	Pass
5	False Input	Entering data that does not match the input column provided	Data cannot be saved, and a warning appears.	Data cannot be saved, and a warning appears.	Pass

Based on the results of Blackbox testing presented in Table 4, all implemented system functions produced the expected outcomes. All data input features operated correctly, and valid data was successfully recorded in the system. In addition, testing scenarios involving invalid or incomplete data inputs confirmed that the system appropriately rejected incorrect entries, ensuring data validity. Data integration among system features also functioned effectively, with each feature correctly influencing related processes. Furthermore, the stock data displayed by the system consistently reflected real-time inventory conditions. Based on the development and testing results, it can be concluded that the AppSheet-based inventory management system operates effectively and fulfills the operational needs of PT XYZ.

Implementation

The final stage of the RAD method involved implementing the developed inventory management system to replace the manual recording method previously used at PT XYZ. To reconfirm the functionality and suitability of the developed system, user acceptance testing was conducted with end users. User Acceptance Testing (UAT) is a testing phase conducted by end users who directly interact with the implemented system to evaluate whether the system meets user requirements and operational expectations. This testing aims to assess the suitability of the system's main functionalities [19] and the effectiveness of the implemented workflows in supporting daily operational activities. By involving end users in real-world use cases, UAT provides validation that the developed system is acceptable, usable, and ready for operational deployment. The following section presents the results of the conducted user acceptance testing.

Table 5. User Acceptance Testing Results

No.	Feature	Feature Scenario	Expected Result	Test Result	Remarks
1	Open Application	Open the application via AppSheet	Able to directly access the system	As expected	Valid
2	Inbound Menu	Open the “IN” menu	Display incoming goods data	As expected	Valid
3	Input Incoming Goods	Enter incoming goods data	Incoming goods data recorded in the system	As expected	Valid
4	Outbound Menu	Open the “OUT” menu	Display outgoing goods data	As expected	Valid
5	Input Outgoing Goods	Enter outgoing goods data	Outgoing goods data recorded in the system	As expected	Valid
6	Production Output Menu	Open the “Production Output” menu	Display production output data	As expected	Valid
7	Input Production Output	Enter production output data	Production output data recorded in the system	As expected	Valid
8	Goods Data	Open the goods data menu	Display goods data	As expected	Valid

Based on the UAT results shown in Table 5, all system features operated as expected. Each tested function, including inbound and outbound data processing, production output recording, and goods data management, was successfully validated by end users. The findings confirm that the developed system meets user requirements and is suitable for operational use. While the UAT results confirm that all system features function correctly, further evaluation is required to assess user satisfaction in terms of ease of use and overall user experience using a likert scale. The following are the results of user satisfaction testing.

Table 6. User Satisfaction Testing

Aspect	Average Score	Category
Ease of use	4,25	Very Good
Ease of Navigation	3,75	Good
Ease of Data Input	4,50	Very Good
Work Efficiency	4,50	Very Good
Average	**4,25**	Very Good

Based on the user satisfaction results presented in Table 6, the developed system achieved an average satisfaction score of 4,25, which falls into the “very good” category. The results indicate that users perceived the system positively across all evaluated aspects, with average scores of 4,25 for ease of use, 3,75 for ease of navigation, 4,50 for ease of data input, and 4,50 for work efficiency in supporting daily operational activities, including inventory recording and data management. Overall, the user satisfaction evaluation confirms that the implemented system meets user expectations and is suitable for continued operational use.

Based on the results of the User Acceptance Testing and the user satisfaction evaluation conducted previously, it can be concluded that the developed system has successfully met user requirements and operational needs. The test results indicate that all system functionality operates as intended. At the same time, the user satisfaction assessment shows positive responses to the system’s ease of use, navigation, and support for daily operational activities. Overall, these findings confirm that users will accept the system and that it is suitable for implementation in supporting inventory management processes.

In future implementations, specific issues may still arise despite the presence of the inventory management system, such as inconsistencies in employee discipline when controlling inventory and potential numerical errors during data input. Therefore, it is recommended that a standardized operating procedure (SOP) be developed to regulate system usage and operational workflows better, thereby minimizing user-related errors and ensuring more consistent inventory control.

Limitations

This study has several limitations. First, the system implementation period was relatively short, limiting the evaluation of its long-term impact on inventory management and operational performance. Second, the quantitative assessment of inventory accuracy improvement could not be entirely conducted because post-implementation stocktaking has not yet been conducted, and financial data on inventory discrepancies were unavailable. Finally, the developed system relies on the AppSheet platform and a spreadsheet-based database, which may limit scalability and system integration in larger operational environments.

Conclusion

Based on the research, it can be concluded that an AppSheet-based inventory management system is an appropriate solution to address the inventory recording problems faced by PT XYZ, which previously relied on manual processes. In practice, this study offers an AppSheet-based digital inventory system that is feasible for small- to medium-sized enterprises and does not require complex technological investments. AppSheet was selected as the development platform due to its ease of development and maintenance. At the same time, the Rapid Application Development (RAD) method was adopted to accommodate the urgent system requirements and relatively simple user needs. User involvement throughout the development process ensured that the system design aligned with operational requirements. After the system was developed, black-box testing was conducted to verify system functionality, followed by implementation. Further validation through User Acceptance Testing and user satisfaction evaluation confirmed that the system met user requirements and was well received, achieving an average satisfaction score of 4,25. Despite several implementation limitations, the system operates reliably and is suitable for daily use. Overall, the developed system is expected to improve inventory accuracy and enhance more consistent inventory management processes.

For future implementation, potential issues may still arise, such as variations in employee discipline in inventory control and numerical errors during data input. Therefore, it is recommended that standardized operating procedures (SOPs) be established to govern system use and operational workflows, thereby minimizing user-related errors and enabling more consistent inventory control.

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