



Digital Transformation of Toko Susu Bahagia: Implementing an E-Commerce System Using the Waterfall Method

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Abstract: The acceleration of information technology advancement necessitates digital system adoption among SMEs to maintain market competitiveness. Toko Susu Bahagia faced operational inefficiencies in inventory management and transaction documentation through manual processes. This research developed a customized e-commerce solution implementing the Waterfall methodology, progressing systematically through requirement analysis, design, implementation, and verification phases. The system architecture utilized PHP (Laravel) framework with MySQL database integration, incorporating essential functionalities: inventory control, order status monitoring, product expiration notifications, and sales analytics. Verification through Black Box Testing yielded a 98% functionality success rate, validating system dependability. Technical obstacles encountered during development included insufficient data validation protocols and limited digital proficiency among users, which were addressed through simplified interface design and enhanced validation mechanisms. The research establishes the practical effectiveness of user-oriented system architecture for small retail enterprises. Operational performance improved through error reduction in manual processes, instantaneous inventory visibility, and expanded market access. The implementation indicates sustained advantages for business growth capacity and technological preparedness. Subsequent research directions may investigate payment gateway integration, language localization capabilities, and responsive design optimization to enhance system versatility.

Keywords: Toko Susu Bahagia; Waterfall Method; Product Management System.

1. Introduction

The rapid advancement of information technology has exerted substantial influence and catalyzed notable transformations across various sectors, particularly within business environments [1]. Digital transformation represents a critical initiative, especially for small and medium enterprises seeking to maintain competitiveness amid global market dynamics [2]. Developing an effective and efficient online sales platform constitutes one viable solution to address these challenges [3]. Toko Susu Bahagia operates as a distribution and retail business specializing in milk and baby supplies that previously employed manual methods for inventory and transaction management, resulting in monitoring difficulties and elevated risk of product expiration. The manual record-keeping approach hindered transaction history visibility and accurate product data management. Furthermore, geographical limitations in customer reach presented additional obstacles to broader store expansion.

Prior research demonstrates that digital systems enhance operational efficiency and extend market coverage. Prastya and Nasution assert that such systems not only broaden market reach but also streamline supply chains, decrease operational expenses, and deliver superior customer service experiences [4]. Hasanah and Sutantri further note that e-commerce system design utilizing the Waterfall model effectively addresses promotional challenges, transaction processing, and reporting requirements for small enterprises, thereby strengthening competitive position and operational performance [5]. Research by Yacob *et al.* (2021) illustrates the efficacy of e-commerce implementation through the Waterfall methodology for improving inventory control and sales reporting in small retail operations, showcasing practical advantages of structured digital solutions for MSMEs [6].

Despite existing literature examining digital system importance for MSMEs, insufficient attention has been directed toward implementations specifically addressing inventory management and integrated reporting customized for small retail operations like Toko Susu Bahagia. Prastya and Nasution (2024) investigated e-commerce application for competitive enhancement, emphasizing market access expansion and business positioning reinforcement [4]. However, their analysis remains confined to strategic benefits without addressing system design, implementation methodologies, or specific operational processes such as inventory or sales reporting. Hasanah and Sutantri (2020) concentrated on e-commerce system design for Hajj equipment retail utilizing the Waterfall model, providing detailed development approaches addressing promotional, transactional, and reporting challenges [5]. Nevertheless, their implementation remains case-specific without broader applicability to diverse small retail operations with varying operational requirements. Reference [6] offers general Waterfall methodology explanation as a software development approach, describing linear progression from requirements through maintenance without presenting applied cases or system designs supporting daily retail business operations.

System implementation success depends substantially on the development methodology employed. The Waterfall method represents a frequently utilized software development approach featuring structured, sequential progression requiring completion of each stage before advancing to subsequent phases [7]. This model has gained widespread adoption across various domains due to its clarity, simplicity, and systematic documentation procedures. Crespo-Santiago and Dávila-Cosme assert that the Waterfall method provides disciplined structure ensuring phase completion sequentially, rendering it particularly suitable for structured projects such as system implementations within educational and institutional settings [8]. Isa *et al.* (2024) emphasize that the Waterfall model facilitates logical progression and predictable project timelines, advantageous for initiatives requiring clearly established objectives and outcomes from inception, exemplified by digital learning platform development [9]. Rachma and Muhlas (2022) contend that compared to alternative approaches like prototyping, the Waterfall model offers superior control for scenarios with stable user requirements and moderate system complexity, making it particularly appropriate for application design within MSME contexts [10].

The application of Waterfall methodology in this research aligns with these findings, as Toko Susu Bahagia's business processes—including inventory monitoring, order processing, and sales reporting—maintain relative consistency and benefit from sequential development cycles. This approach enables focused completion of each phase with precision, minimizing integration error risks and ensuring functional alignment with user expectations. Based on Toko Susu Bahagia's operational challenges, this research aims to design a system for managing product data, inventory, transactions, and sales reporting while expanding store reach through implementation of the Waterfall method. The system seeks to replace manual record-keeping, automate reporting functions, and facilitate broader market access via an online platform.

2. Related Work

Research on e-commerce adoption for small businesses reveals multiple advantages for operational efficiency and market competitiveness. Prastya and Nasution (2024) examined how e-commerce strengthens business positioning by expanding market access beyond geographical limitations. Their research showed that digital platforms allow small enterprises to reach previously inaccessible customer segments while optimizing supply chains and reducing operational costs [4]. Hasanah and Sutantri (2020) analyzed e-commerce system design for a religious goods retailer using the Waterfall methodology. Their study documented how systematic development addressed specific business challenges in promotion, transaction processing, and reporting. The sequential approach proved valuable for businesses with clearly defined operational needs [5]. Yacob *et al.* (2021) studied e-commerce adoption among Indonesian micro, small, and medium enterprises (MSMEs), finding that digital systems significantly improved inventory control and sales reporting capabilities. Their research established that structured digital solutions provide practical benefits for small retail operations, particularly in managing stock and tracking sales performance [6]. Agitha *et al.* (2023) designed an e-commerce system specifically to increase sales productivity for home industries in Indonesia. Their work demonstrated how digital platforms can help small-scale producers overcome traditional market limitations and increase revenue through expanded customer reach [17].

The transition to digital business models presents various challenges for small enterprises. Priyadarshani Gamage (2023) identified barriers to e-commerce adoption among small businesses, noting that technical knowledge gaps, implementation costs, and organizational readiness significantly affect adoption success. The study recommends phased implementation approaches to overcome these barriers [18]. Sifwah *et al.* (2024) investigated digital marketing as a strategy to enhance MSME competitiveness. Their research emphasized that digital transformation requires not only technological implementation but also strategic marketing approaches tailored to online environments to effectively compete in increasingly digital marketplaces [2]. Chen (2024) examined strategic visual communication for small business success in online e-commerce, finding that effective visual presentation significantly impacts customer engagement and purchase decisions. The research suggests that visual elements must be carefully integrated into e-commerce systems to maximize their effectiveness [19]. Sharma (2023) studied positive impacts of e-commerce adoption by SMEs, documenting revenue growth, operational efficiency improvements, and market expansion outcomes. The research indicated that successful e-commerce implementation correlates with business sustainability and growth capacity [20]. Tisyani and Sushandoyo (2023) analyzed how e-commerce platforms reinforce business agility for Indonesian MSMEs. Their case studies revealed that digital platforms enable small businesses to respond more quickly to market changes and customer preferences, creating competitive advantages through flexibility [21].

The Waterfall method maintains relevance for structured system implementations across various domains. Badrul and Ardy (2021) applied the Waterfall method to develop a student registration information system, demonstrating its effectiveness for projects with clearly defined requirements and sequential processes [7]. Crespo-Santiago and Dávila-Cosme (2022) established that the Waterfall method provides necessary structure for implementing library projects, where systematic documentation and phase completion are essential for successful outcomes. Their research validates the method's applicability in information management contexts [8]. Wan Mohd Isa *et al.* (2024) employed the Waterfall model to develop an educational website about traditional medicinal plants. Their work confirmed the method's value for educational content development, where logical flow and predictable timelines support effective knowledge transfer [9]. Rachma and Muhlas (2022) compared Waterfall and Prototyping models for Android-based learning application design. Their analysis revealed that Waterfall offers superior control for scenarios with stable user requirements and moderate complexity, making it particularly suitable for MSME application development [10].

Wahid (2020) analyzed the Waterfall method for information system development, identifying its strengths in documentation, verification, and quality assurance. The research noted that sequential development reduces integration errors when requirements remain relatively stable throughout the project lifecycle [12]. Sopriani *et al.* (2023) designed a web-based inventory information system using structured development approaches. Their implementation demonstrated how systematic methods support accurate stock tracking and reporting functions, which align with the needs of retail businesses like Toko Susu Bahagia [14]. Musthofa and Adiguna (2022) designed a web-based e-commerce application for computer spare parts using CodeIgniter framework. Their work illustrates how structured development methodologies support specialized retail operations with inventory management requirements [15].

3. Research Method

This research uses a software engineering method based on the Waterfall model. A software development model that uses a sequential and systematic approach, there are five main stages, namely requirements, system design/design, implementation, testing, and maintenance [11]. This method is in accordance with the needs that have been defined from the beginning, so that the potential for errors can be minimized [12]. The Waterfall model was chosen in this study because it offers a structured workflow that is suitable for system development with clearly defined requirements from the start. Unlike Agile or Scrum, which are more flexible and iterative, Waterfall is considered more appropriate in this context as the scope and user needs of the system are relatively stable and do not require frequent changes.

1) Requirements

The needs analysis stage conducted interviews with partners, namely Toko Susu Bahagia, to obtain information related to the functional and non-functional needs of the system to be created. The interview was conducted online with the store to explore the ongoing business processes, obstacles faced, and features needed. The interview used a semi-structured format to allow deeper probing of business problems and expectations. It involved one store owner with the session lasting approximately 50 minutes. The data were collected using the Zoom platform, with important points documented manually for subsequent analysis.

2) System Design

At this stage, system design is carried out, including the preparation of database structures using Entity Relationship Diagrams (ERD) and modeling business processes and user interactions through use case diagrams and activity diagrams. The Entity Relationship Diagram (ERD) was chosen to clearly represent the structure of database tables and the relationships between entities such as Kategori, Barang, Barang Masuk, Barang Keluar, Pesanan, Detail Pesanan, and Notifikasi. The diagram enables the identification of primary keys, foreign keys, and data dependencies, which are essential for maintaining relational integrity and efficient data retrieval. Use case diagrams were used to describe the interactions between system actors (admin and customer) and the main system functionalities. Meanwhile, activity diagrams were utilized to model the sequential flow of operations and the interactions between users and the system. These diagrams describe processes such as login authentication, product and stock management, order placement, transaction processing, and notification handling, providing a clear visual understanding of how each feature operates step-by-step within the system. These three diagrams complement each other by covering data relationships (ERD), actor-function interactions (use case), and process flows (activity), forming a comprehensive foundation for the system architecture.

3) Implementation

The system was developed using the PHP programming language and the Laravel framework. The database is designed using MySQL, based on the results of the analysis of the needs that have been obtained previously. Specifically, PHP version 8.2.12 and Laravel version 11.17.0 were used in the development process, with MySQL 8.2.12 as the relational database management system. The development was conducted in a local environment using XAMPP as the server stack and the Visual Studio Code editor. Git was used for version control and backup during development.

4) Testing

Testing is done using the black-box testing method to ensure each function runs properly. In addition, a user acceptance test was also conducted involving several users from the store. The black-box testing focused on input-output validation for each core function. Testing scenarios were created for scenario, expected result, observation result, and testing result. Success criteria were determined by the system's ability to produce expected outputs and appropriate error handling. Meanwhile, the user acceptance test involved one user from Toko Susu Bahagia (admin) who was asked to use the system for common tasks and provide feedback. The test results were analyzed qualitatively to identify usability issues and areas for refinement.

5) Maintenance

This stage involves bug fixes based on testing results as well as system enhancements based on user feedback. In the long term, a structured maintenance plan is prepared to ensure the system remains functional, secure, and relevant. The plan includes monthly data backups, periodic system performance reviews, and annual updates to accommodate potential business growth. Routine hosting maintenance is also planned, including server uptime monitoring, security patch updates, and storage optimization to ensure continuous system availability. Additionally, future development strategies include integration with payment gateways to support real-time transactions and enhance the customer experience.

4. Result and Discussion

4.1 Results

3.1.1 Requirements

At this stage, interviews were conducted with the owner of Toko Susu Bahagia to obtain information related to the needs of the system to be created. The following are the results of interviews with the owner of Toko Susu Bahagia.

Table 1. Functional requirement

Functional Requirements	Description
Login and Logout	Admins can log in and out of the system.
Item Data Management, Goods In/Out	Admins can add, edit, delete, and view the list of items.
Item Category Management	Admin can set product categories to facilitate search
Admin Dashboard	Admins can view items that are selling well, out-of-stock items, expired items this month, the number of incoming items, the number of outgoing items, the daily/monthly sales amount graph, and the monthly total profit graph.
Notifications	The system provides an alert that there are incoming orders and items that will expire
Order management	Admin can manage the customer order status
Report and Export Report	Admin can view and download daily/monthly reports in PDF format
Product Search and Filter	Customers can search and filter items by category
Shopping Cart	Customers can add, subtract, and delete items from the cart
Checkout and Booking	Customers can make purchases and complete transactions
Order Status Tracking	Users can see the progress status of orders that have been made

Table 2. Non-Functional requirement

Non-Functional Requirements	Description
Data Security	The system uses authentication and authorization to protect data and transactions.
Ease of Use	Designing user interfaces that are easy to understand and use
System Availability	The system can be accessed anytime, 24/7
Accessibility	The system is designed to be expandable according to the needs of the store
Scalability	The system can be accessed on various devices

After conducting direct interviews, the system for Toko Susu Bahagia must be able to support operational activities, both in terms of functional and non-functional aspects. The findings from this interview served as the primary foundation for designing the architecture and features of the system for Toko Susu Bahagia. By understanding in detail the needs of partners, the development of this system is expected to not only solve existing problems but also provide added value for the growth of Toko Susu Bahagia's business. At this stage, the system requirements were designed to directly respond to the problems identified earlier, particularly in managing inventory, transaction history, and expanding service reach. The functional requirements, such as stock in/out recording, notification of item expiration, and PDF-based reporting, were formulated to address those pain points. Compared to general e-commerce systems, this requirement model includes more tailored features like expiration alerts and admin-specific dashboards. During the requirement-gathering process, one challenge encountered was translating informal needs from the store owner into formal system requirements. To overcome this, the interview was conducted in a semi-structured format, allowing clarification through example-based questioning and real-world use case scenarios. The decision to include specific modules like notification for expiring items, categorized search, and a simple dashboard layout was based on the partner's daily operational limitations, which require clear, minimal-step processes to avoid user confusion.

3.1.2 System Design

The system design phase is conducted by referring to the results of the needs analysis obtained through interviews with partners, specifically Toko Susu Bahagia. The primary goal of this phase is to formulate a system design that aligns with the functional and non-functional requirements that have been previously determined. System design is carried out with a structured approach that includes the creation of diagrams such as Entity Relationship Diagrams (ERD), Use Case Diagrams, and Activity Diagrams. These three models

describe the data structure, business process flow, and interaction between users and the system. The system design was developed to directly address the problems found during the needs analysis phase. By translating these needs into ERD, Use Case, and Activity Diagrams, the system was designed to support operational clarity and minimize ambiguity in implementation. The following are the results of the design process:

1) Entity Relationship Diagram (ERD)

An Entity Relationship Diagram (ERD) is a technique used to map data requirements in an organization, generally carried out by system analysts at the needs analysis stage in system development projects. ERD also serves as one of the database modeling methods that aims to produce a conceptual scheme based on the semantic data model of the designed system [13]. In this design, seven interrelated entities are designed. The first entity is Category, which stores information about the different types or groups of goods available. This entity has attributes such as category ID and category name, and forms a one-to-many relationship with the Goods entity, so that one Category can be related to many goods. The Goods entity records details of products sold in the store, including product name, price, unit weight, available stock, and product image. Goods have a direct relationship with categories and form relationships with the Goods In, Goods Out, and Order Details entities to support stock and transaction management. Furthermore, the Incoming Goods entity is responsible for recording each stock entry into the store. The information stored includes the date and time of entry, quantity of goods, purchase price, expiration date, recipient's name, and origin of goods. This entity is directly related to goods as a reference for stock updates. The Outgoing Goods entity is designed to document data related to sales transactions, encompassing the date and time of the transaction, the quantity of items sold, the name of the seller, and the calculation of profit. Relationships with the goods and goods-in entities are needed to ensure the accuracy of stock tracking and transaction history. The Order entity stores data on orders placed by customers, including information such as the order's name, address, phone number, total price, order status, expedition type, proof of payment, and a unique order number (order ID). This order is then closely related to the Order Detail entity. The Order Detail entity serves as a bridge between orders, goods, and incoming goods. Through this entity, the details of each product ordered are recorded, including the number of items ordered and the unit price of each product. In addition, the Notifications entity is designed to store various system notifications for users, such as order status information, product expiration reminders, and stock depletion notifications. Each notification has attributes such as notification type, read status, and a reference ID that links it to the corresponding order or incoming item. The relational structure between entities can be seen in the following figure:

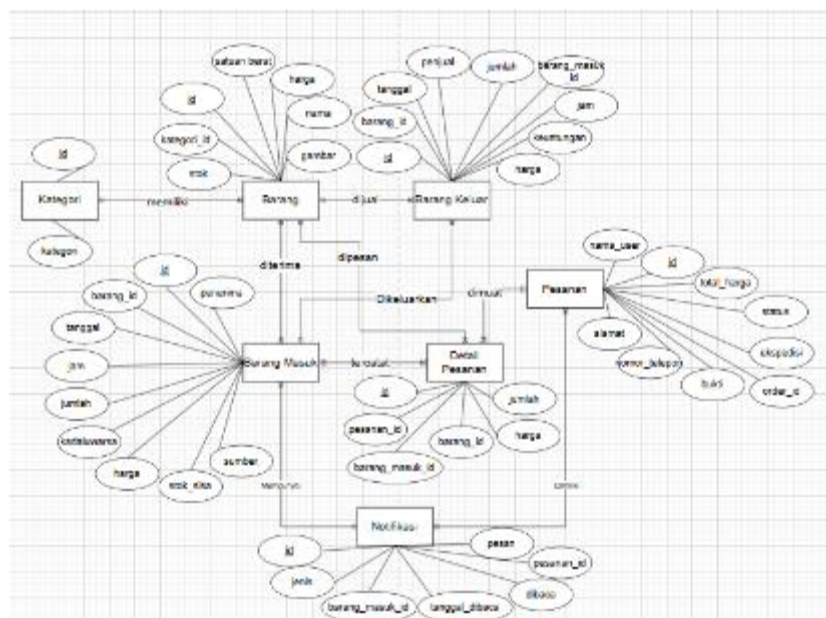


Figure 1. Entity Relationship Diagram

2) Use Case

Use Case Diagrams are utilized to illustrate the interactions between actors (users of the system) and the key functionalities offered by the system. This diagram models system behavior through the interaction of one or more actors with the information system being built, thus helping to identify the functions available and who has the right to use them [14]. In the Toko Susu Bahagia system, there are two main actors, namely Customer (customer) and Admin (store manager). Each actor has different access rights and functions according to their role. The customer actor acts as an end user who interacts directly with the system to carry out the product purchase process. Access rights owned by customers include the ability to view a list of items

based on available categories, view detailed information from each item, add items to the shopping cart, reduce the number of items in the cart, delete items from the cart, perform the checkout process to complete the purchase, and track the status of orders that have been placed.

Meanwhile, the Admin actor has full access rights to manage all data and activities in the system. Admins can log in to the website to enter the system and log out to exit the system. Admins also have access to view information displayed on the dashboard, add new item data to the system, edit existing item data, and delete item data that is no longer available. In addition, Admins can manage incoming goods data by adding, editing, and deleting records of goods entering stock. In terms of outgoing stock management, Admins can add outgoing goods data, make edits to the data, and view a list of outgoing goods that have been recorded. Admins are also responsible for viewing and managing system notifications, such as notifications regarding new orders or items approaching expiration. In addition, Admins can change the status of customer orders according to the transaction process's progress, view daily and monthly sales reports, and export reports in a downloadable format. The use case diagram is presented in the following figure:

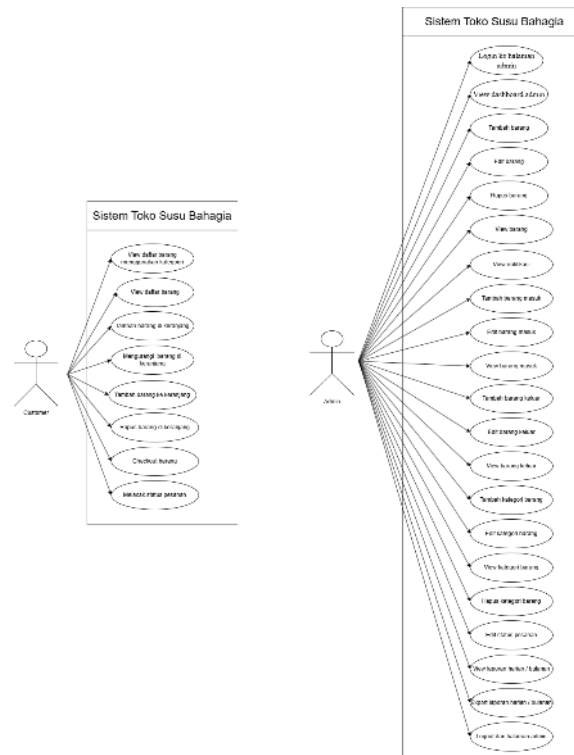


Figure 2. Use Case Diagram

This Use Case provides a comprehensive overview of how the system will be used by each actor and is the basis for designing the interface and functions to be developed.

3) Activity Diagram

An Activity Diagram serves to represent the flow of activities or processes that take place within the system. This diagram describes the sequence of actions performed by the user or system vertically, resembling the sequence of the course of a process until a certain task or function is completed [15]

. In the system of Toko Susu Bahagia, the preparation of activity diagrams is based on the main functionality that has been identified in the needs analysis and system design stages. This diagram models various important business process flows, including the admin login process into the system, item data management, which includes activities to add, edit, and delete product data, as well as inbound and outbound stock management. In addition, the activity diagram also represents the activity of managing item categories that aim to facilitate product grouping, as well as the customer interaction process in selecting products, adding items to the cart, performing the checkout process, and tracking the status of orders that have been made. Not only that, the management of notifications that serve to provide alerts related to orders or stock items is also modeled in detail in this diagram. The process of exporting sales reports by admin, both daily and monthly reports, is also visualized to show the flow of administrative activities in the system. This activity diagram offers a clear visual depiction of the complex business processes within the system and serves as a crucial reference during the system implementation phase. With this modeling, system development can be more directed, efficient, and in accordance with user needs. The activity diagram is presented in the following figure:

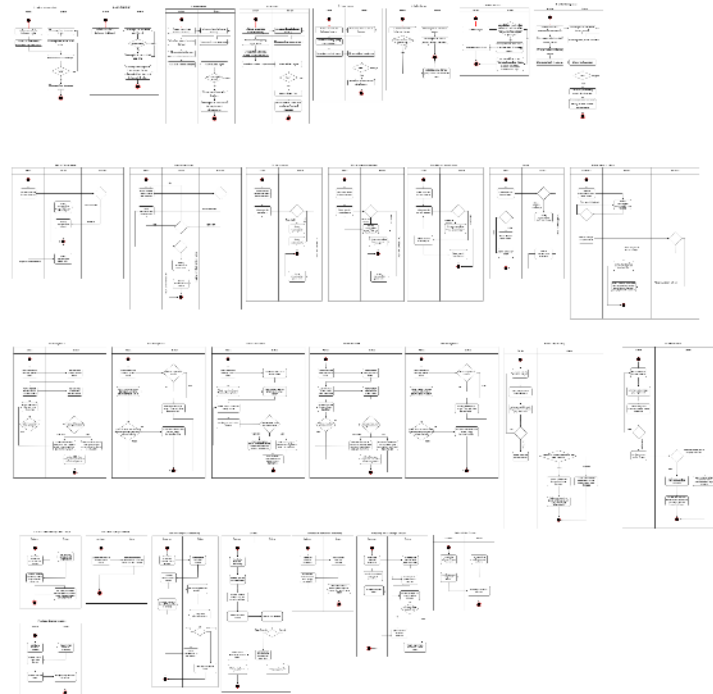


Figure 3. Activity Diagram

3.1.3 Implementation

This stage of implementation involves applying the outcomes of the system analysis and design into a tangible system that can be operated. The Toko Susu Bahagia system was built using the PHP programming language, utilizing the Laravel framework, and employing a MySQL database. This implementation produces a user interface that is responsive and supports the operational needs of the store, both from the admin and customer side. The following is a view of the system that has been developed. The main page is the initial display that customers will see when accessing the Toko Susu Bahagia website. This page is designed with an attractive and user-friendly appearance as a visual representation of the store's identity (Figure 4).



Figure 4. Home Page of Toko Susu Bahagia



Figure 5. About Toko Susu Bahagia Page

This page serves to provide visitors with general information about Toko Susu Bahagia's profile. It provides an explanation of the background of the establishment of the store, the physical location of the store, and the vision and mission carried out. The design of this page is made attractive and informative, complete

with visual illustrations and store photos to strengthen customer confidence in the store's identity. In addition, this page also provides a "Click to Chat" button feature as a customer interaction with the admin directly, facilitating the communication and customer service process (Figure 5). The track order page is provided to assist customers in monitoring their order status independently. On this page, users can simply enter the order ID that was received after the checkout process to view the details of the order that was placed. The design of this page is simple yet functional, with a two-column display that separates ordering information and shipping data, making it easier for customers to read and understand their order details. This feature significantly contributes to enhancing transparency and building customer trust in the developed online store system (Figure 6).

Figure 6. Track Order Page

Figure 7. Shopping Cart Page

The shopping cart page serves as a temporary place to store the products that have been selected before proceeding to the checkout stage. On this page, customers can see a list of items to be purchased (Figure 7). The checkout page is the final stage in the process of purchasing products by customers. On this page, customers are asked to fill in personal information such as name, WhatsApp number, and shipping address. In addition, the system also displays order details automatically based on the items that have been put into the shopping cart. On the right side of the display, there is an additional form that must be filled in by the customer, which is the selected shipping expedition and provides proof of payment confirmation in the form of an image. The system will automatically calculate the total price based on the quantity and type of products ordered (Figure 8).

Figure 8. Order Checkout Page

Figure 9. Login Page for Admin

The login page is the main authentication stage that must be passed by the admin before accessing all management features in the system. To access the management features, the admin must enter the username and password that have been registered. This authentication process guarantees that data management within the system is restricted to authorized users only (Figure 9). The dashboard page serves as a summary display of important information for admins, such as total sales, number of items sold, sales charts, best-selling product lists, and out-of-stock items. This dashboard helps admins monitor store performance quickly and

efficiently (Figure 10). On this dashboard page, Business Intelligence (BI) principles are applied, where data is presented visually and structured to support fast and accurate decision-making. With graphs and performance indicators, admins can easily identify the most sold products and items that need to be added to stock immediately. This dashboard is used as a monitoring and analysis tool to improve operational efficiency and formulate more effective sales strategies (Figure 11).

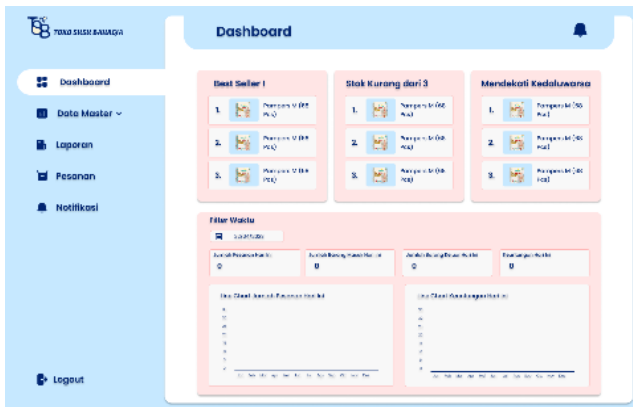


Figure 10. Admin Dashboard Page



Figure 11. Item Page

The goods page is used by the admin to manage product data available in the store. On this page, the admin can see a complete list of items along with categories, prices, units, and product images. There are also action buttons to edit and delete data, as well as an "Add" button to enter new products into the system (Figure 11). The incoming goods page is used to record information on each product that enters the stock. The data displayed includes item name, entry date, quantity, expiration date, price, source, and recipient. Admins can add new data, as well as edit or delete existing data through the available action buttons (Figure 12).

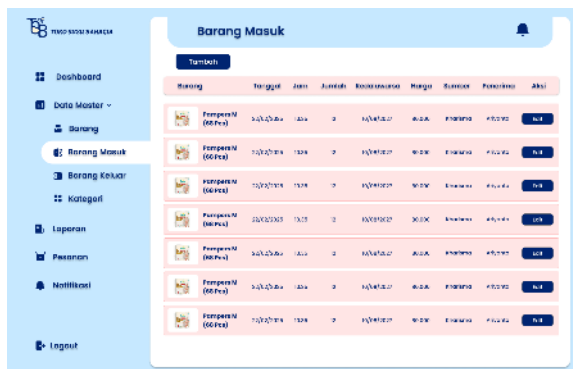


Figure 12. Incoming Goods Page



Figure 13. Outgoing goods page

The outgoing goods page is used to record information on items that have been sold or removed from stock. The information displayed includes the item name, date and time, quantity, unit price, and seller name. Admins can add new data as well as edit and delete outgoing goods data through the available action buttons (Figure 13). The item category page is used by the admin to manage the list of product categories available in the store. Each category can be added, changed, or deleted through the available action buttons. This category management aims to simplify product classification so that it is more structured when displayed to customers (Figure 14). The sales report page presents complete outgoing goods transaction data, including item name, date, time, quantity, price, and seller name. Admins can filter reports based on specific date ranges and months, and download reports in PDF format. This feature facilitates the process of recapitulating and evaluating store sales periodically (Figure 15). The order page presents a list of transactions completed by customers, including details such as the order ID, time of order, total payment amount, and the current status of the order. Admins can monitor the entire order history and also manually change the order status, such as "Waiting", "Processed", "Shipped", or "Completed", according to the progress of the delivery process. This makes it easy to manage transactions and track shipments in real-time (Figure 16). The notification page displays various important alerts related to store operations. Notifications include information on items that are approaching their expiration date, as well as notifications of new orders from customers. This feature helps the admin to take immediate action, both in stock management and order processing, in a timely manner (Figure 17).

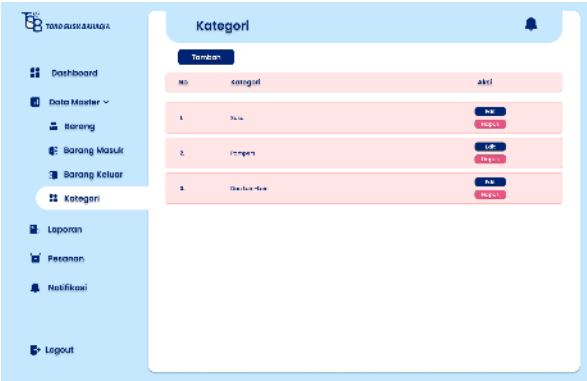


Figure 14. Item Category Page

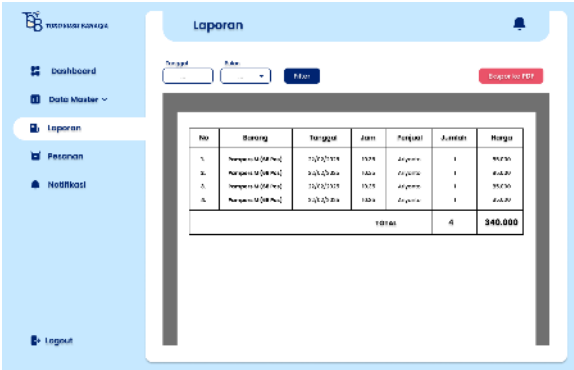


Figure 15. Sales Report Page

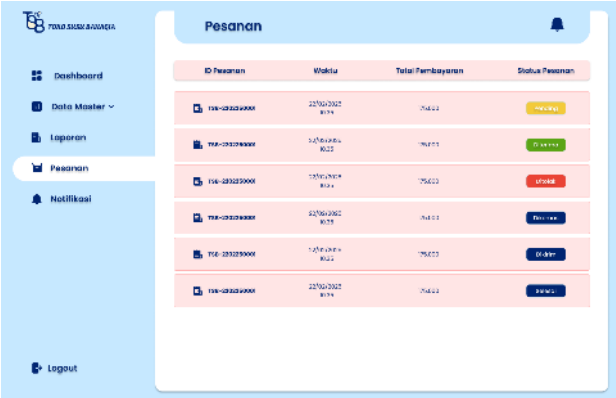


Figure 16. Order Page



Figure 17. Notification Page

3.1.4 Testing

The Toko Susu Bahagia system is tested using the Black Box testing method. The purpose of this test is to ensure that all application functions operate according to the designed specifications and to verify whether the produced output matches the expected results. Black Box testing also aims to evaluate the system in handling input and output processes, identifying errors, and ensuring that the system is able to operate consistently and free of functional glitches. Thus, this testing is an important stage to detect potential errors that may occur and to assess whether the application is ready to be used in the actual operational environment.

Table 3. Testing the system of Toko Susu Bahagia.

Page	Scenario	Expected Results	Testing Results
Order Tracking Page	The customer enters a valid order ID and clicks "Track order"	The system displays order status and details	Successful
Shopping Cart Page	Customers can add or reduce the number of items in the cart	The number of items increased or decreased	Successful
Order Checkout Page	Customers can complete the checkout process with complete data	The system saves the order data	Successful
Login Page for Admin	forAdmin can enter a valid username and password	Admin can log in to the system	Successful
Item Page	Admin clicks the "Add item" button and fills in the item data	The new item is saved and appears in the item list	Successful
Incoming Goods Page	Admin records incoming goods data with the correct data	Incoming goods recorded and stock updated	Successful
Outgoing Goods Page	Admin records outgoing goods with the correct data	Outgoing goods data is saved, and stock is reduced	Successful

Item Page	CategoryAdmin can add new category data	The new category appears in the category list	Successful
Order Page	Admin can change the order status	Order status changed, and notification sent to user	Successful
Notification Page	Admin receives notifications of items approaching their expiration date, as well as notifications of incoming orders.	Admin receives notification	Successful

System testing has been conducted on the Toko Susu Bahagia application and resulted in an overall accuracy rate of 98%. The tests covered a range of key features from both the admin and customer perspectives, and in general, the system performed as expected across most functions. There were two failures identified in the checkout process, where the system allowed input lengths that exceeded the 255-character limit in the name and address fields, even though the input should not exceed 255 characters. These failures were caused by missing or ineffective frontend input validation, which failed to enforce the expected character restriction. Although they did not impact the core functionality of the system, these issues have been documented and will be addressed in future development stages to improve system resilience against edge case inputs.

3.1.5 Maintenance

The maintenance stage is carried out after the Toko Susu Bahagia system has been implemented and is used by users. Maintenance is intended to ensure that the system remains operational and can adapt to evolving user needs in the future. Some of the initial maintenance activities carried out include bug fixes found during the testing process, particularly addressing input validation issues in the checkout process, where the system allowed input lengths that exceeded 255 characters. In addition, interface adjustments were made based on early user feedback to improve usability and visual clarity. Improvements were also made in terms of system performance to ensure that it remains responsive when accessed. From a long-term perspective, a structured maintenance plan has been prepared, including regular data backups, periodic performance evaluations, and hosting maintenance such as uptime monitoring and security updates. This ensures the system remains reliable and scalable as the business grows. Planned future development includes the integration of payment gateways and the implementation of a mobile-responsive interface, aiming to enhance functionality and user accessibility.

4.2 Discussion

The system developed for Toko Susu Bahagia presents a targeted solution to address the specific operational challenges identified in the early stages of analysis. The inventory management problem, especially related to stock availability and expiration tracking, has been successfully mitigated by the integration of the notification system and stock input/output recording. These features directly contribute to minimizing human error and improving store responsiveness. This aligns with findings by Martins *et al.* (2020) who emphasized the importance of effective notification systems in enhancing operational responsiveness in smart environments [16]. Compared to other e-commerce systems such as Shopify or local e-commerce CMS like Sirclo Store, the developed system offers features that are more aligned with the day-to-day operational needs of small physical stores, including local notifications on item expiration, manual order tracking, and dashboard simplification for non-technical users. This is consistent with findings by Agitha *et al.* (2023), who emphasize that customized e-commerce designs for home industries in Indonesia significantly increase operational relevance and productivity [17].

During development, several technical and non-technical challenges were encountered. One technical challenge was ensuring data validation across multiple user forms, which led to the identification of input validation gaps during testing. These were mitigated by improving both frontend and backend validation layers. On the non-technical side, understanding user expectations and workflows without prior digital exposure proved complex. This reflects barriers to e-commerce adoption previously outlined by Priyadarshani Gamage (2023), where limited digital literacy and infrastructure readiness among small businesses often hinder implementation [18]. This was resolved through continuous iteration and prototype-based feedback with the store owner. The choice of Laravel as the development framework was based on its robustness, community support, and integrated security features. The UI was deliberately kept minimalistic to reduce learning curves for admins who are not familiar with digital interfaces. This design philosophy aligns with the usability requirement and has shown positive feedback during early user tests. According to Chen (2024), visual and interface simplicity significantly supports user adoption in small business e-commerce by reducing friction and enhancing clarity [19]. This approach helps ensure that the system remains accessible even for users with minimal technical background.

The system testing phase yielded a 98% success rate, with only two minor validation issues, confirming the system's reliability and performance. This quantitative metric gives an objective foundation for assessing functionality. Future evaluations could include user satisfaction surveys or real-time performance metrics like response times or load handling. These additional metrics would align with Sharma (2023), who emphasizes the need for continuous measurement and optimization to support sustainable growth in e-commerce-based SMEs [20].

However, the system does have limitations. In particular, it currently lacks an integrated payment gateway. These were not prioritized due to initial time and resource constraints, but are part of the roadmap for future enhancement. In terms of academic relevance, the system supports the growing body of research that underscores the importance of contextually adapted e-commerce platforms for SMEs. Studies such as Agitha *et al.* (2023) and Sharma (2023) emphasize that systems tailored to local operational contexts—particularly for micro and small enterprises—lead to increased productivity and sustainable adoption [17][20]. This implementation provides practical validation of those insights through a co-designed digital system developed specifically for a small retail business in Indonesia. The findings reinforce that focused, user-centered solutions yield higher usability and business impact than generalized e-commerce platforms, as also echoed by Tisyani and Sushandoyo (2023) [21].

5. Conclusion

Based on the research and development results obtained, the implementation of the Waterfall method in developing systems for Toko Susu Bahagia has proven to be structured and systematic. This method allows each stage, from needs analysis to system testing, to be carried out sequentially so as to minimize errors and ensure the system is built according to user needs. With the Waterfall approach, the development process can be more controlled because each stage is completed completely before continuing to the next stage.

The system developed is able to meet the needs of partners, such as product data management, order processing, order tracking, and management of incoming and outgoing goods. The main features provided have been adapted to the business flow of Toko Susu Bahagia, so as to replace the previous manual process with a more efficient digital solution. Through this implementation, the store can perform more accurate and organized stock management, including recording incoming and outgoing goods. In addition, the system supports the online ordering process, from product selection and checkout to order status tracking. With the dashboard page, the admin can monitor sales transactions directly, view best-selling products, find out products with limited stock, and identify items that are approaching expiration. The available report page also makes it easy for admins to recap transactions and document them in the form of PDF files.

One of the key findings from this research is that the system achieved a 98% success rate during testing using the Black Box method, indicating high reliability and alignment with the functional requirements. Each feature successfully delivers the expected output, indicating that the system is reliable in executing its core functionalities. The notification feature for expiring items and the simplified interface design have significantly improved store responsiveness and minimized human error, directly addressing the inventory management issues identified in the early analysis. With this system, it is expected that Toko Susu Bahagia can improve operational efficiency in stock management, transactions, and sales reporting. In addition, through the online ordering feature, the store can expand the range of services to customers more widely and easily. These outcomes reflect a tangible digital transformation of a previously manual workflow, offering enhanced accuracy, real-time data accessibility, and broader service reach. However, this study also has several limitations. The system does not yet support integrated payment gateways, multilingual functionality, or mobile optimization, which could be essential for scalability. Future research is expected to explore the integration of advanced features such as real-time analytics, customer feedback systems, and adaptive interfaces to support broader adoption and sustainability in similar small business contexts.

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