

Implementation of the Waterfall Model in the Design and Development of a Web-Based Cashier Information System

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Abstract

This research aims to design and develop a web-based cashier information system using the Waterfall software development model. The system is designed to support sales transaction processes, product data management, and financial reporting more effectively and efficiently. Problems commonly found in conventional cashier systems, such as transaction recording errors, delays in data recap, and difficulties in accessing information, form the background of this development. The Waterfall method was chosen because it provides systematic and structured stages, including requirements analysis, system design, implementation, testing, and maintenance. In the analysis stage, user needs were identified through observation and interviews. The design stage employed UML diagrams such as use case diagrams, activity diagrams, and class diagrams to illustrate the system flow. The system was implemented using PHP programming language and MySQL database, while testing was carried out using the black box testing method to ensure all functions operated according to requirements. The results of the study show that this web-based cashier information system can process sales transactions quickly, reduce data input errors, and facilitate stock management and report generation. Thus, the application of the Waterfall model has proven effective in developing a measurable, maintainable system that meets user needs in small and medium-sized enterprises.

Keywords

Cashier Information System; Sales Management; Software Development; Waterfall Model; Web-Based.

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Introduction

The rapid advancement of information technology over the past decade has led to significant changes across various sectors, particularly in business operations and financial management. Digital transformation has compelled organizations and business actors to adapt by implementing information systems that enhance efficiency, accuracy, and speed in data processing activities (R Mehta, 2025). One widely required application of information technology is a web-based cashier information system,

which serves as a primary tool for managing sales transactions and financial records in an integrated and systematic manner (Khadapi et al, 2023).

In practice, conventional cashier systems that are still operated manually often cause various problems, such as transaction recording errors, delays in reporting, and difficulties in monitoring inventory levels (Umam et al, 2025). These issues can lead to financial losses and hinder effective managerial decision-making. Therefore, an online, integrated, and highly accurate cashier information system is required. Web-based systems offer an effective solution, as they can be accessed anytime and anywhere through an internet connection, making them highly suitable for the needs of modern businesses.

The development of an effective cashier information system requires an appropriate methodological approach. One of the most widely used software development models is the Waterfall model. First introduced by Royce in 1970, this model remains relevant due to its systematic structure and ease of implementation, particularly for projects with clearly defined requirements. The Waterfall model consists of sequential stages, including requirements analysis, system design, implementation, testing, and maintenance (Sallu et al, 2023). This approach allows developers to minimize errors and ensure that each phase is properly completed before moving on to the next stage.

In the context of cashier information systems, the Waterfall model is considered suitable because such projects typically have stable and well-defined requirements from the outset. The requirements analysis phase serves as a crucial foundation to ensure that the system meets user needs, both in transaction processing and reporting functions. Subsequently, the system design phase utilizes UML diagrams to illustrate process flows and relationships among system components. This stage plays a vital role in facilitating program implementation using programming languages such as PHP and databases like MySQL, which are recognized for their flexibility and efficiency (Sotnik et al, 2023).

The implementation of a web-based cashier information system also supports operational effectiveness and resource efficiency (Lediwara et al, 2025). This system enables business owners to conduct sales transactions automatically, calculate total payments, manage customer data, and generate financial reports instantly (Saputra et al, 2023). In addition, web-based systems offer advantages in terms of scalability and ease of updates, as administrators can modify the system without requiring reinstallation on each user device.

However, the development of a cashier information system is not without challenges. One major issue is users' limited understanding of the technology, along with infrastructure constraints such as unstable internet connectivity in certain regions. Therefore, beyond technical considerations, socialization and user training are also necessary to ensure smooth adaptation to the new system. The Waterfall model helps reduce these risks because each development phase is carried out sequentially and thoroughly documented, allowing revisions to be made more easily when discrepancies arise between user requirements and system implementation outcomes (Hussain et al, 2024).

The design of a web-based cashier information system also supports real-time processing principles, enabling transactions to be processed instantly and results to be displayed without delay (Ramadhani et al, 2025). This capability is crucial in retail businesses that handle a high volume of daily transactions. Through an integrated system, business owners can monitor inventory levels, daily revenue, and financial reports via an interactive dashboard. Furthermore, database integration allows faster data retrieval and analysis, which ultimately supports strategic decision-making.

The role of a cashier information system extends beyond transaction processing and functions as an internal control mechanism within a business. Automated and standardized data recording helps

reduce the potential for fraud and enhances financial transparency. The system can also be equipped with user authorization features to restrict access based on roles such as cashier, manager, and administrator. As a result, all activities can be monitored and traced clearly, thereby improving operational accountability.

From an academic perspective, this study is expected to contribute to the development of knowledge in the fields of information systems and software engineering, particularly regarding the implementation of the Waterfall model in web-based systems. This research may also serve as a reference for system developers and small and medium-sized enterprises (SMEs) in designing technological solutions that align with business needs. Additionally, the findings can provide a foundation for future studies using alternative development models, such as Agile or Prototype, to compare their effectiveness in the context of cashier systems.

Accordingly, this study focuses on how the Waterfall model can be optimally applied in the design and development of an efficient, accurate, and user-friendly web-based cashier information system. The research not only highlights technical development aspects but also evaluates the system's impact on operational effectiveness and user satisfaction. The implementation of this system is expected to offer a practical solution for business owners in improving productivity, minimizing transaction errors, and accelerating financial reporting processes.

The relevance of web-based cashier information systems continues to grow alongside advancements in information technology that drive digital transformation across organizations. The primary objective of implementing a digital cashier system is to address the weaknesses of conventional manual systems, such as recording errors, reporting delays, and difficulties in inventory monitoring, all of which may lead to financial losses. Web-based cashier systems overcome these limitations by providing anytime and anywhere access while delivering real-time data presentation (Kahar et al, 2024).

Recent studies have highlighted the efficiency of transaction management in small and medium-sized enterprises through the use of web-based cashier information systems (Rondonuwu et al, 2025). These studies indicate that web-based cashier applications are capable of managing sales transaction data in real time, automatically calculating total payments, managing inventory, and generating financial reports instantly. Such systems not only reduce recording errors and speed up transaction processes but also support business owners in decision-making and accountability. Based on these findings, it can be concluded that the adoption of web-based systems with automated transaction recording and efficient data management significantly enhances productivity and accelerates financial reporting processes in the era of economic digitalization.

The web-based concept plays a central role in the development of this cashier system, as it allows access anytime and anywhere via the internet. This advantage provides high flexibility and enables real-time data presentation. From a technical perspective, the system is developed using specific web technologies: PHP is utilized as the programming language, while MySQL serves as the database management system. On the front-end side, HTML, CSS, and JavaScript are employed to create an interactive and responsive user interface. The interface design follows user-centered design principles to ensure ease of use for non-technical users such as cashiers and business owners.

A web-based cashier information system represents a crucial implementation of technological advancement aimed at managing sales transactions and financial data in an integrated manner, replacing manual processes that often cause operational issues. The primary functions of the system include automatic transaction recording and total payment calculation. In addition, the system supports inventory management by handling stock data and customer information. Administrators are granted the ability to manage master data, including store profiles, product categories, product details,

and member data. The system also provides an important feature to display low-stock items, facilitating effective inventory monitoring and restocking decisions.

The Waterfall model is a classical, systematic, and structured software development methodology. This model is selected in the study due to its suitability for projects with clearly defined requirements and its appropriateness for cashier system development, where specifications and functionalities tend to remain stable from the outset. Each phase of the model is executed sequentially and thoroughly documented to minimize errors and ensure that the final outcome aligns with user requirements. The development stages begin with Requirements Analysis, which involves identifying the system's functional and non-functional requirements as the foundation for preparing the system requirements documentation. This is followed by the System Design phase, which employs modeling tools such as UML (Unified Modeling Language) to illustrate the system architecture, data flows, and database structure to be implemented.

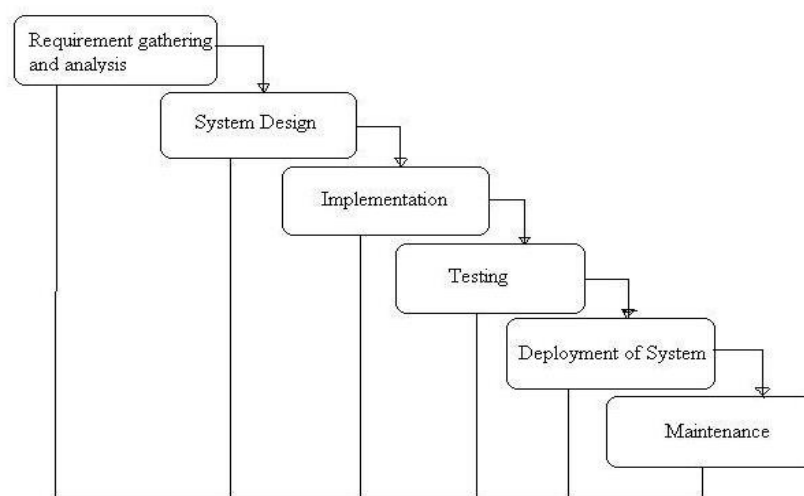


Figure 1. System Design Diagram Using the Waterfall Method

Black box testing is a system testing method used to evaluate the functionality of each system component without examining the source code. The purpose of this testing is to ensure that every feature operates in accordance with the requirement specifications defined during the analysis phase. In the context of the cashier information system, testing is conducted on the main modules, including the transaction module, inventory management module, reporting module, and user login module. The application is tested solely from the user's perspective, without any knowledge of the internal code structure or program logic, to verify that all functionalities perform as intended.

Methodology

The system requirements analysis for the design and development of a web-based cashier application includes both functional and non-functional requirements to support the primary objective of the system, which is to simplify sales transaction processes and enable efficient management of product data and financial reports. From a functional perspective, the application provides features such as user registration and login for cashiers and administrators to ensure transaction data security. It also supports product data management, including input, editing, and deletion of items, so that stock levels and prices remain up to date according to actual conditions. In addition, the application offers a sales transaction feature that allows cashiers to scan barcodes or select products, with the system automatically calculating the total price and change.

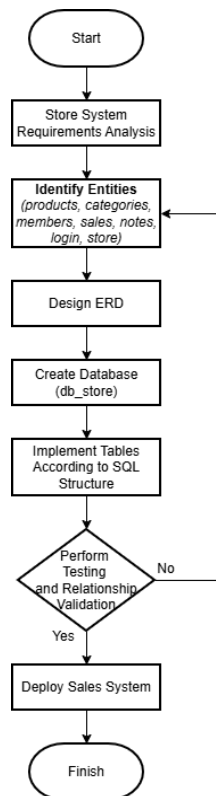


Figure 2. Research Flowchart

The application further supports transaction receipt printing as proof of payment, real-time inventory management, and the generation of daily, weekly, or monthly sales reports that can be downloaded by administrators. Search and data filtering features are also provided to accelerate the retrieval of specific products or transactions. In terms of non-functional requirements, the cashier application emphasizes system security through login data encryption and role-based access control. The user interface is designed to be simple, responsive, and easy to use for non-technical users. Moreover, the system delivers high performance, enabling fast transaction processing without interruptions, and maintains high availability so that it can be accessed online during operational hours without downtime that could disrupt sales activities.

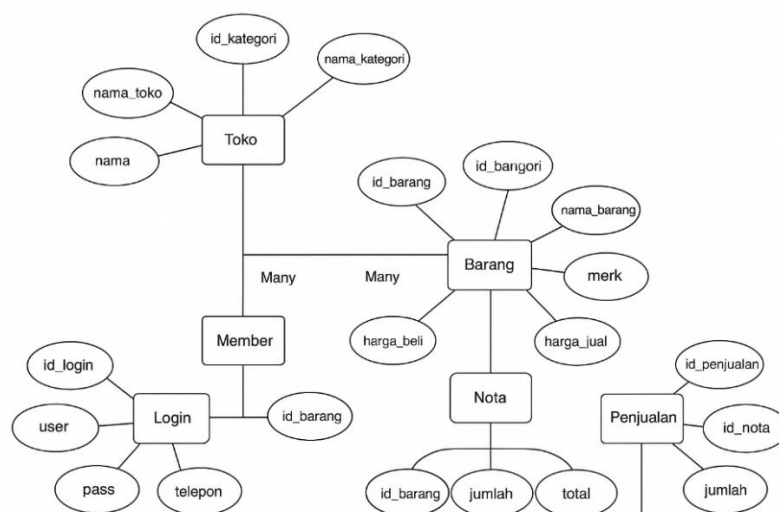


Figure 3. ERD Diagram (Entity Relationship Diagram)

The application is also designed to be easy to maintain, allowing it to be updated and further developed in accordance with future needs. Overall, the system is expected to assist both business owners and cashiers in accelerating transaction processes, reducing recording errors, and presenting sales data accurately, efficiently, and in real time. With the implementation of this system, store operational activities become more organized, and data-driven decision-making can be carried out more quickly and effectively.

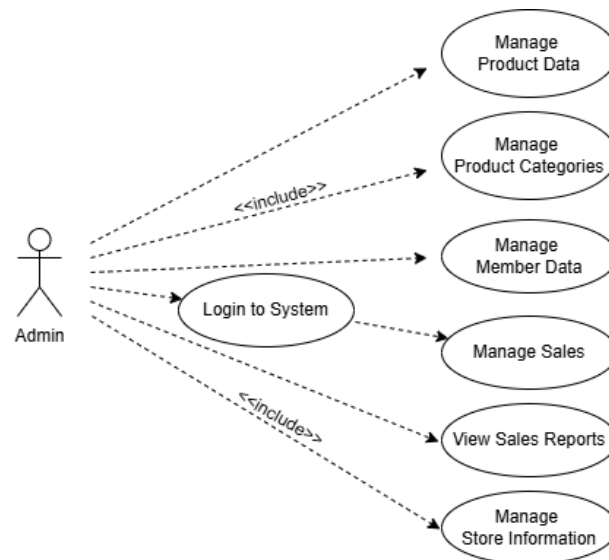


Figure 4. Admin Use Case Diagram

Results and Discussion

Results

The following section presents the results of implementing the web-based cashier application developed using the Waterfall method. The system is capable of handling sales transactions in real time through a simple and user-friendly interface. The application also provides integrated product data management features, making stock recording easier and minimizing input errors. The generated financial reports include automatic summaries of daily, monthly, and annual transactions, enabling business owners to evaluate sales performance quickly and accurately. Black box testing results indicate that the main functionalities, such as transaction recording, product data searching, and report generation, operate in accordance with user requirements.

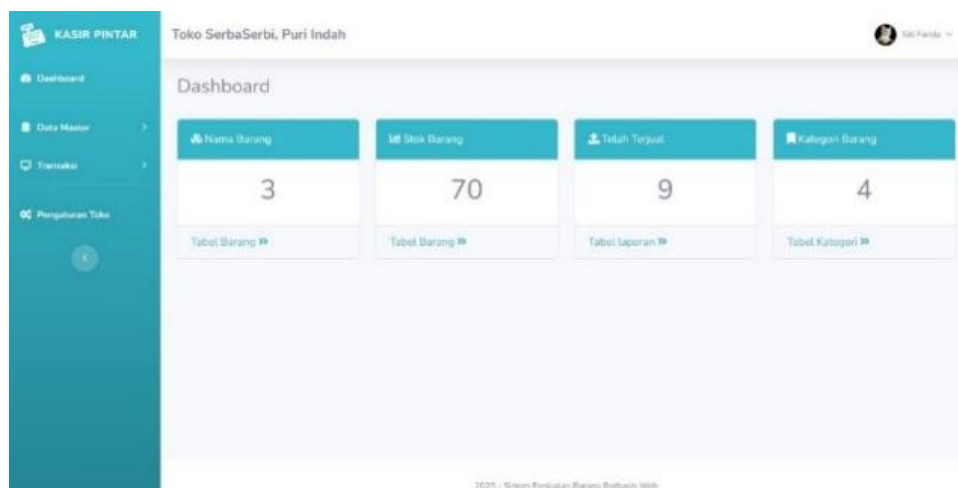


Figure 5. Dashboard Page

Figure 6 illustrates the main dashboard page of the web-based cashier system “Kasir Pintar” used by Toko SerbaSerbi, Puri Indah. After the administrator logs in, the system displays a summary of key data, including the number of products, stock levels, sales, and categories. This page is also equipped with a sales graph that provides a visual overview of sales performance over a specific period, enabling the administrator to easily monitor business progress.

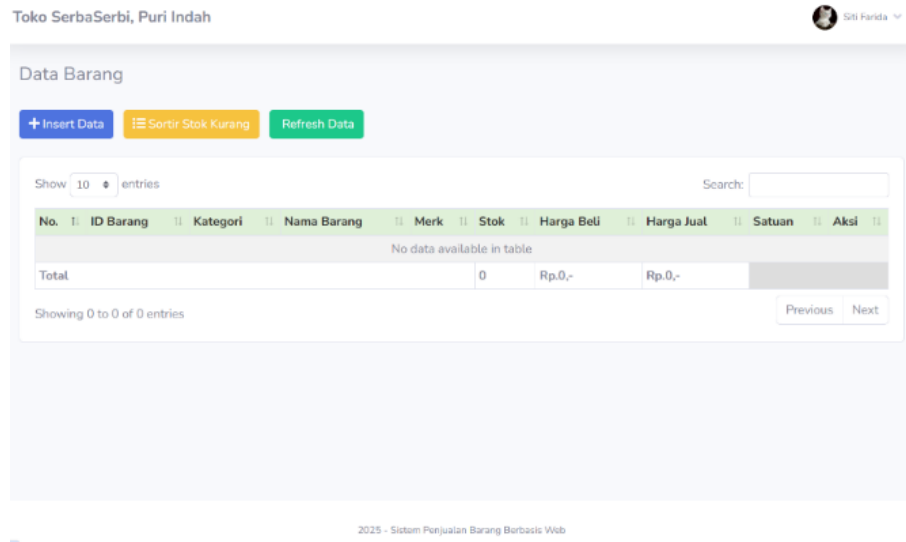


Figure 6. Product Data Page

Figure 7 presents the product data page of the web-based cashier system, which serves as the central interface for managing store inventory. Through this page, users can add new product data along with detailed information such as category, product name, brand, purchase price, selling price, and unit. The page is also equipped with a feature that displays items with low stock levels to facilitate monitoring and restocking activities. With these features, the system helps maintain product availability and improves overall store operational efficiency.

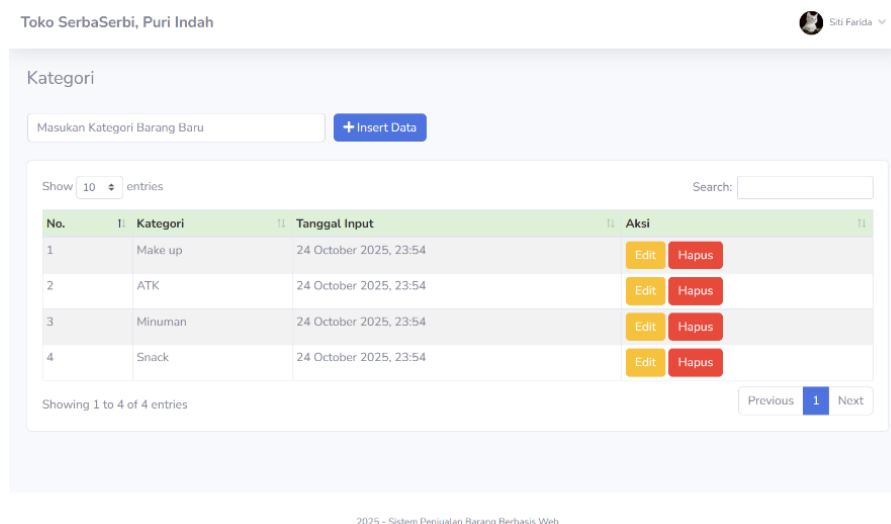


Figure 7. Category Page

Figure 8 shows the category page of the web-based cashier system, which is used to manage product categories within the application. This page allows users to add, edit, and delete categories to ensure

that products are well organized, thereby facilitating easier product management and more efficient transaction processing.

Figure 8. Sales Cart Page

Figure 9 illustrates the Sales Cart page of the web-based cashier system, which is used to manage sales transactions in real time. Users can search for products by scanning barcodes and then add items to the cart. Transaction details such as product name, quantity, total price, and cashier name are displayed in a table. The page also provides features to set the transaction date and a Reset Cart button to clear all temporary data.

This interface is designed to make the sales process faster, more accurate, and easier to monitor. In addition, the page includes automatic calculations for the total payment and change, thereby minimizing errors associated with manual calculations. Users can proceed directly to the payment process once all items have been added. The responsive interface design allows the page to be easily accessed across various devices, such as cashier computers, tablets, and smartphones. With these features, the system enhances cashier efficiency and delivers a more practical and professional transaction experience.

No	ID Barang	Nama Barang	Jumlah	Modal	Total	Kasir	Tanggal Input
1	BR002	Handbody	1	Rp.35,000,-	Rp.5,000,-	Siti Farida	2025-10-24 12:22:09
2	BR003	Bedak	1	Rp.30,000,-	Rp.10,000,-	Siti Farida	2025-10-24 12:21:05
3	BR001	lipstik	1	Rp.0,-	Rp.2,000,-	Siti Farida	2025-10-24 12:21:02
4	BR001	lipstik	1	Rp.70,000,-	Rp.5,500,-	Siti Farida	2025-10-24 12:20:55
5	BR003	Bedak	2	Rp.60,000,-	Rp.4,000,-	Siti Farida	22 October 2025, 18:42

Figure 9. Sales Report Data Page

The figure above displays the sales report data page, which contains transaction information based on specific periods such as daily, monthly, or yearly intervals. Users can filter data by date, display results using the Search or Refresh buttons, and export the data to Excel format. The report table

includes detailed information such as product ID, product name, quantity, total price, cashier, and transaction time. This feature enables business owners to monitor sales performance and prepare reports efficiently.

Figure 10. Store Setting Page

Figure 11 shows the Store Settings page of the web-based cashier system, which allows administrators to manage store-related information such as store profile details, contact information, and other configuration settings. This page enables easy updates and customization of store data to ensure that system information remains accurate and aligned with operational needs.

Discussion

In this study, system testing was conducted with several users using both administrator and cashier accounts to ensure that all available features operate in accordance with the store's daily operational needs. The testing process employed the black box testing method, which focuses on evaluating system functionality based on input and output without considering the internal implementation of the program code. Through this approach, each module was tested from the end-user's perspective to determine whether the system produces the expected results.

The testing was carried out systematically and covered key features such as sales transaction processing, product data management, report generation, and differentiated access rights between administrators and cashiers. This aimed to ensure that the cashier system not only functions optimally but is also user-friendly for individuals with varying levels of technological proficiency. Furthermore, the testing process helped identify potential errors or system limitations at an early stage, allowing improvements to be made before the system was fully deployed in store operations. Consequently, the testing results are expected to provide assurance that the developed cashier system effectively supports efficiency and effectiveness in daily transaction activities.

Table 1. Blackbox Testing for the Cashier System

No	Test Scenario	Input	Expected Output	Test Result
1	Login with valid credentials	Valid email and password	User successfully accesses the main dashboard	Successful
2	Login with invalid credentials	Invalid email or password	System displays an error message "Invalid email or password"	Successful

No	Test Scenario	Input	Expected Output	Test Result
3	Register a new account	Valid name, email, and password	Account is saved and can be used to log in	Successful
4	Register with an already registered email	Email already exists	System displays a warning message "Email already registered"	Successful
5	Add course schedule	Course name, day, time, and room	New schedule is stored in the schedule table	Successful
6	Edit course schedule	Modified schedule data	Schedule data are updated in the schedule table	Successful
7	Delete course schedule	Click delete button on schedule data	Schedule data are removed from the schedule table	Successful
8	Add new task	Task name, description, and deadline	Task is stored in the task table and displayed on the dashboard	Successful
9	Edit task	Modified task data (deadline/status)	Task data are updated in the task table	Successful
10	Delete task	Click delete button on task	Task data are removed from the task table	Successful
11	Change task status to completed	Click check/status button	Task status changes to "Completed" and is highlighted in green	Successful
12	Filter tasks by schedule	Select a specific course	Displayed tasks match the selected schedule	Successful
13	Logout	Click logout button	System terminates the session and redirects to the login page	Successful
14	Interface responsiveness	Access via different devices (laptop, smartphone)	Interface remains proportional and navigation functions properly	Successful

Conclusion

Based on the results of the analysis and evaluation of the implementation of the Waterfall model in the development of a web-based cashier information system, it can be concluded that this method is effective in improving system efficiency, accuracy, and reliability. The implementation results show that the Waterfall model provides a systematic and well-structured development framework, allowing

each phase—starting from requirements analysis, system design, implementation, to testing—to be carried out properly and documented clearly.

In terms of efficiency, the web-based cashier system developed using the Waterfall model is able to speed up transaction processes, reduce manual workload, and accelerate the generation of real-time sales reports. Transactions that previously took several minutes can now be completed within seconds, while financial reports can be accessed directly without the need for manual recapitulation. From an accuracy perspective, the system successfully minimizes recording and data input errors through automatic validation features. Each transaction is verified by the system to ensure data consistency, thereby significantly reducing human error and producing accurate reports to support managerial decision-making.

Regarding reliability and stability, the system demonstrates good performance even under high transaction volumes. A well-designed system architecture ensures resilience against technical issues and maintains stability when accessed by multiple users simultaneously. Comprehensive documentation also facilitates system maintenance and future development. From the user perspective, the implementation of this system increases cashier job satisfaction and overall operational efficiency. A simple, responsive user interface, along with fast search and reporting features, makes the system easy to use for users with varying levels of technological proficiency.

Overall, the application of the Waterfall model in developing a web-based cashier information system has a positive impact on improving efficiency, accuracy, and operational convenience. This method is particularly suitable for systems with clear requirements, high stability needs, and a well-defined project scope, especially for small and medium-sized enterprises that require a reliable, structured, and sustainable digital solution.

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