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DIGITAL TRANSFORMATION OF LOGISTICS MANAGEMENT THROUGH A WEB-BASED BARCODE-INTEGRATED SHIPMENT INFORMATION SYSTEM

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Abstract

This study aims to design and implement a web-based shipment information system integrated with barcode technology to improve the efficiency and accuracy of goods delivery management at PT. Anugerah Fajar. The existing shipment management process relied heavily on manual recording methods, which resulted in data entry errors, delays in updating shipment status, and limited visibility of goods in transit. To address these issues, a barcode-based information system was developed to automate shipment identification, tracking, and reporting processes. The system was developed using the Rapid Application Development (RAD) methodology, which emphasizes iterative development and active user involvement. Data were collected through direct observation, interviews with administrative and field personnel, documentation analysis, and literature review. The proposed system includes core features such as user authentication, shipment data management, barcode scanning using one-dimensional (1D) barcodes, real-time shipment status updates, report generation, and system configuration. The results show that the implemented system successfully improves operational efficiency by reducing manual data entry and minimizing human errors in shipment recording. Real-time barcode scanning enables faster and more accurate shipment status updates, enhancing transparency and control throughout the distribution process. Additionally, the dashboard and reporting features support effective monitoring, documentation, and managerial decision-making. The findings indicate that integrating barcode technology into a web-based shipment information system provides a practical and scalable solution for modern logistics management. This research contributes to the field of information systems by demonstrating the effectiveness of barcode-based digital solutions in improving logistics operations within distribution companies.

Keywords: barcode technology; shipment information system; logistics management; web-based system; rapid application development.

1. INTRODUCTION

Barcode technology has become one of the most widely used automatic identification tools in the logistics and goods distribution sector. By utilizing patterns of vertical lines and spaces that can be read by optical scanners, barcodes are capable of storing important information quickly, accurately, and efficiently. The implementation of barcode technology enables standardized tracking and data recording processes, thereby minimizing errors caused by manual data entry. The reliability of this technology has been proven to enhance operational efficiency across various sectors, including manufacturing, retail, and delivery services [1].

On the other hand, shipment data information systems constitute a crucial component of the distribution chain in companies such as PT. Anugerah Fajar. These systems function to record, manage, and monitor the movement of goods from warehouses to end customers. With a structured information system in place, each stage of the shipment process can be digitally documented, facilitating data traceability, report generation, and strategic decision-making. The integration of information systems with identification technologies such as barcodes serves as an essential foundation for creating transparent and efficient logistics systems [2].

However, to date, PT. Anugerah Fajar still faces challenges in monitoring shipment processes that are largely conducted manually. Data recording is often performed using handwritten notes or basic spreadsheets, which are prone to errors and data duplication. Furthermore, delays in updating shipment statuses result in limited visibility of goods in transit, making it difficult for management to provide accurate and timely information to customers. This condition not only reduces operational efficiency but also has the potential to decrease customer satisfaction due to delayed information [3].

As a solution to these challenges, the implementation of a barcode-based information system represents a strategic approach for PT. Anugerah Fajar. By integrating barcode technology into the shipment information system, each shipped item can be assigned a unique, scannable label that allows for easy tracking. Field personnel can simply scan the barcode to update shipment status in real time, ensuring data accuracy and accessibility at any time.

In addition to improving accuracy and operational efficiency, the system enhances distribution transparency and simplifies logistics auditing. This digital transformation is expected to drive the company's shipment operations toward a more modern, fast, and reliable logistics environment[4].

To accelerate the system development process and ensure active user involvement, this study employs the Rapid Application Development (RAD) methodology. The RAD approach enables iterative and interactive application development, beginning with requirements planning, system design, prototype development, and continuing through testing and implementation phases. Through this approach, system development becomes more flexible, as user feedback can be directly incorporated into each iteration cycle, resulting in a final system that closely aligns with real-world operational needs [5]–[7]. Previous research conducted by [8] focused on designing a web-based sales application integrated with a barcode scanner at CV Kalima Sejahtera. The existing transaction management process relied heavily on manual methods, leading to a high risk of errors and inefficiencies in stock and sales recording. The proposed web-based system aimed to improve business process accuracy and efficiency.

The objective of this research is to design and implement a web-based shipment information system integrated with barcode technology at PT. Anugerah Fajar in order to improve efficiency and accuracy in managing shipment data. This study aims to reduce reliance on manual recording processes that are prone to input errors and delays in data updates, while enabling real-time monitoring of shipment status. In addition, the research seeks to enhance transparency in the distribution process, facilitate systematic documentation, reporting, and logistics auditing, and support more effective managerial decision-making. The application of the Rapid Application Development (RAD) methodology is intended to ensure that the developed system aligns closely with user and operational requirements through an iterative, flexible, and user-oriented development process, thereby enabling optimal implementation in the company's logistics operations [9].

2. RESEARCH METHOD

2.1. Research Design

This study adopts an applied research approach with a system development perspective, focusing on the design and implementation of a web-based shipment information system integrated with barcode technology. The research is conducted as a case study at PT. Anugerah Fajar, aiming to address real operational problems related to manual shipment data management. The applied research design is chosen to ensure that the developed system provides practical solutions and measurable improvements in logistics efficiency, accuracy, and transparency [10]–[12].

2.2. Research Object and Location

The object of this research is the shipment data management process at PT. Anugerah Fajar, a company engaged in goods distribution and logistics services. The research is conducted at the company's operational environment, where shipment recording, tracking, and reporting activities are carried out. The selection of this location is based on the company's reliance on manual data recording methods, which present challenges in data accuracy, timeliness, and monitoring of shipment status.

2.3. Data Collection Methods

Data collection in this study is carried out using several techniques to obtain comprehensive and reliable information. Direct observation is conducted to understand existing shipment workflows and identify operational issues. Interviews are held with administrators and field personnel to gather user requirements and system expectations. Documentation studies are also performed by examining existing shipment records, reports, and administrative documents. In addition, a literature review is conducted to support system design and development by referring to previous studies, textbooks, and scientific publications related to barcode technology and logistics information systems.

2.4. System Development Method

The system development in this research employs the Rapid Application Development (RAD) methodology due to its iterative and user-centered characteristics. RAD consists of several stages, including requirements planning, user design, system construction, and testing and implementation. This approach enables rapid prototyping and continuous user involvement throughout the development process, allowing feedback to be incorporated directly into system improvements. As a result, the developed system aligns closely with user needs and operational conditions in the field[13]–[15].

2.5. System Architecture and Design

The system architecture is designed as a web-based application that integrates barcode scanning functionality with a centralized database. The system workflow includes user authentication, shipment data entry, barcode scanning, shipment status updates, and report generation. The database is structured to store shipment details, user

information, and tracking history in an organized manner. System design is supported by process flow diagrams and database schemas to ensure consistency, scalability, and ease of system maintenance.

2.6. Barcode Technology Implementation

Barcode technology is implemented as the primary identification and tracking mechanism within the shipment information system. Each shipment item is assigned a unique one-dimensional (1D) barcode that represents its shipment code. Barcode scanning is performed using a barcode scanner integrated into the web application through a scanning engine, enabling automatic data input and real-time status updates. This implementation reduces manual data entry, minimizes errors, and ensures accurate and efficient tracking of goods throughout the delivery process.

3. RESULTS AND DISCUSSION

3.1. Implementation system

After the completion of this research, the next stage was the system implementation. The developed system consists of several functional pages, each designed to perform specific roles according to user requirements.

1. Login Page

   Figure 1 illustrates the login page of the PT. Anugerah Fajar information system. On this page, users are required to enter a username and password as an authentication process before accessing the system. The login feature serves to ensure data security and restrict system access to authorized users only.

Figure 1. Login Page

2. Dashboard Page

   Figure 2 presents the dashboard page of the PT. Anugerah Fajar information system. This page displays a summary of key data, including the total number of shipments, total users, monthly shipment statistics in graphical form, and shipment status distribution charts. The dashboard is designed to provide a quick overview of system activities and conditions, enabling administrators to monitor and manage shipment operations in real time.

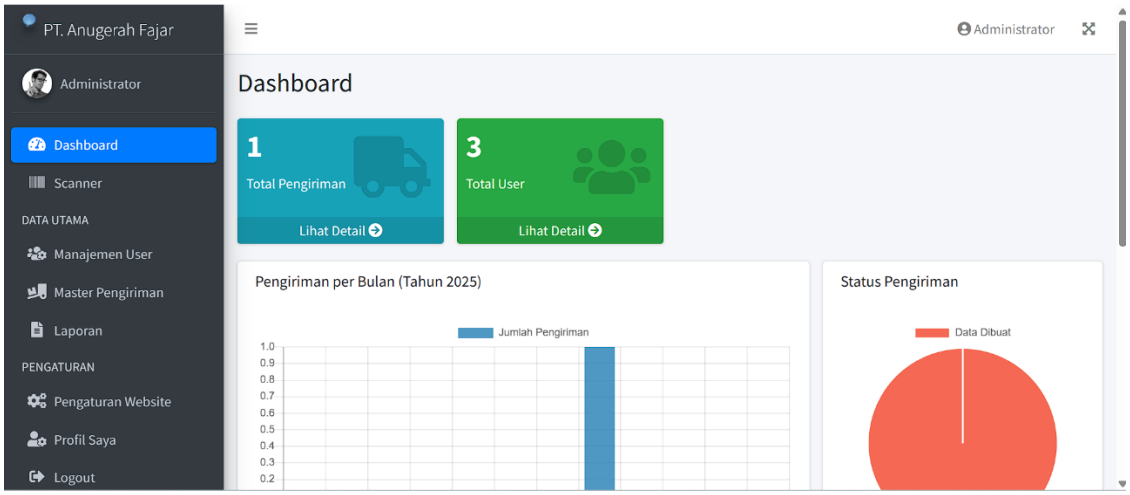

Figure 2. Dashboard Page

3. Scanner Page

Figure 3 shows the Shipment Scanner page of the PT. Anugerah Fajar information system. This feature is used to scan one-dimensional (1D) barcodes on shipment items using the ZXing Engine, allowing shipment data to be recorded automatically. In addition, a manual input option is provided in cases where the barcode cannot be scanned, ensuring flexibility and accuracy in data entry.

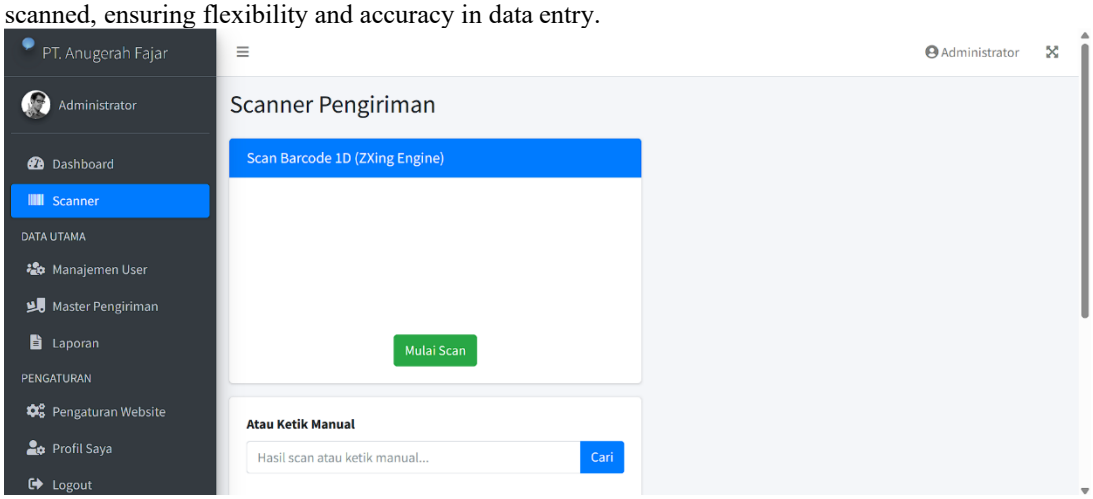

Figure 3. Scanner Page

Figure 4 displays the barcode scanning result notification on the Shipment Scanner feature. The system shows a “Success” message to indicate that the shipment code has been successfully scanned, along with the unique shipment identification code. This feature ensures that shipment data is recorded accurately and in real time, facilitating field personnel in updating shipment status.

Figure 4. Scan Result

Figure 5 illustrates the Shipment Detail and Status Update page. This page presents shipment information such as shipment code, recipient name, destination, and current status. Users can update the shipment status by adding new information, including status updates, location, and optional notes.

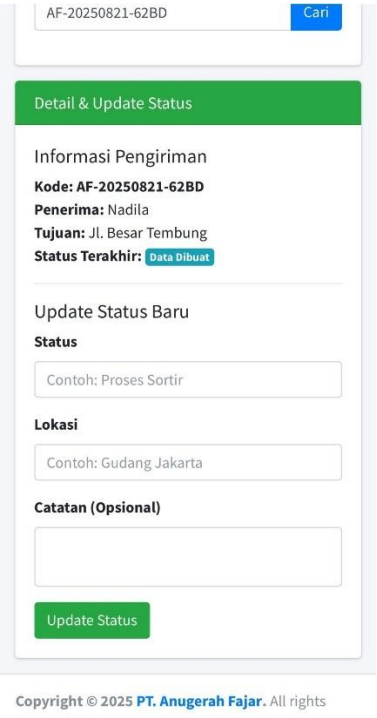

Figure 5. Shipment Status Update Page

4. User Management Page

Figure 6 shows the User Management page of the PT. Anugerah Fajar information system. Through this page, administrators can add, edit, and delete user data. The displayed information includes user photos, names, usernames, roles, phone numbers, and available action options. This feature is designed to facilitate the management of user access rights according to their respective roles and responsibilities.

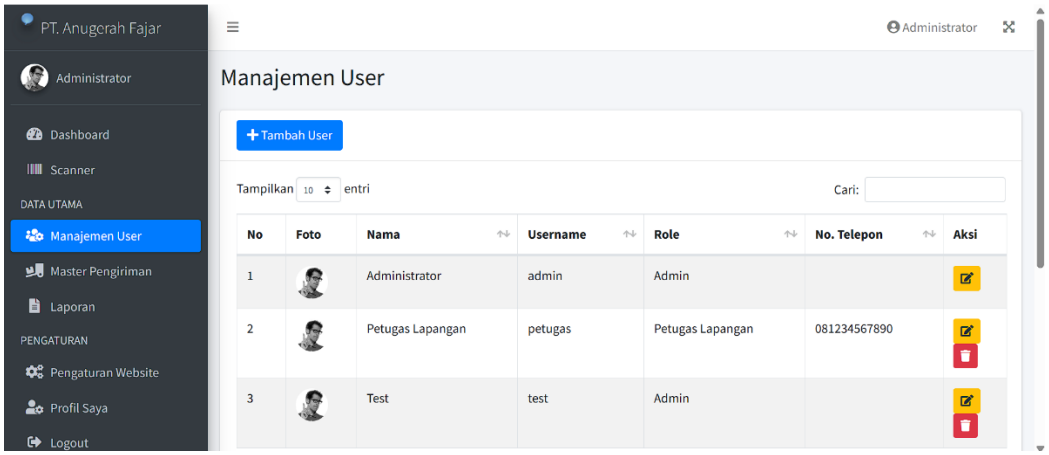

Figure 6. User Management Page

5. Shipment Master Data Page

Figure 7 presents the Shipment Data page of the PT. Anugerah Fajar information system. This page is used to manage all shipment records, including shipment codes, sender names, recipients, destination addresses, shipment status, and creation dates. Administrators can add new shipment data using the "Add Data" button and perform actions such as viewing details, editing, or deleting records through the available action menu.

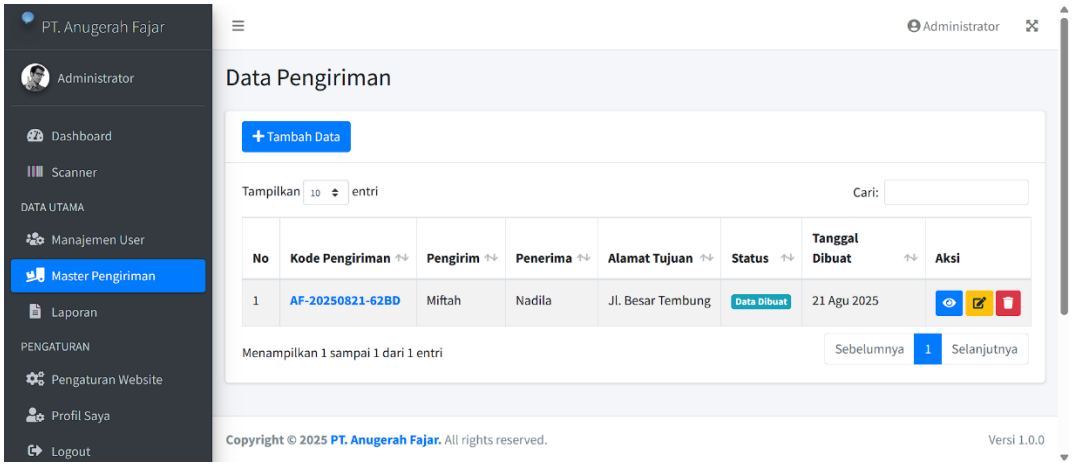

Figure 7. Shipment Master Data Page

6. Report Page

Figure 8 shows the Shipment Report page of the PT. Anugerah Fajar information system. This feature allows users to filter reports based on a selected date range, enabling shipment data to be displayed according to a specific period. The information presented includes shipment codes, senders, recipients, destinations, current status, and creation dates. Additionally, a Print/Save as PDF option is provided to facilitate official report generation, making the documentation and archiving process more efficient and well-structured.

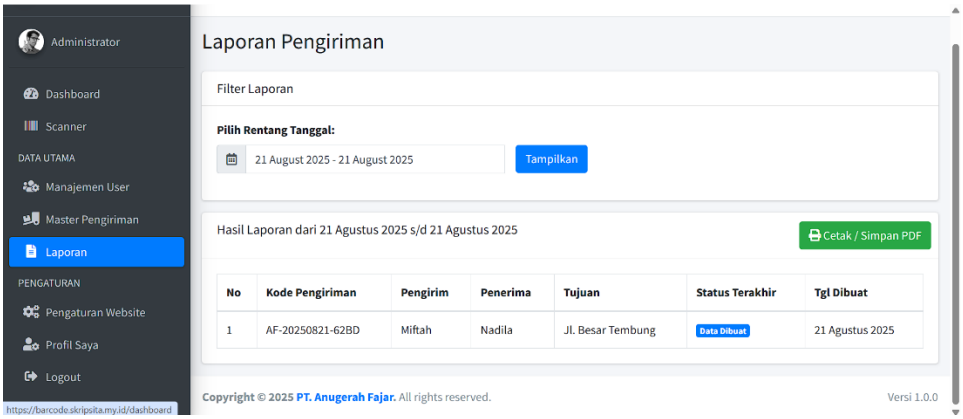

Figure 8. Halaman Report Page

7. Website Settings Page

Figure 9 displays the Website Settings page of the PT. Anugerah Fajar information system. Through this page, administrators can manage basic website information such as the website name, description, logo, and favicon. This feature provides flexibility for the company to customize the system's appearance and identity according to organizational needs, making the system more professional and easily recognizable.

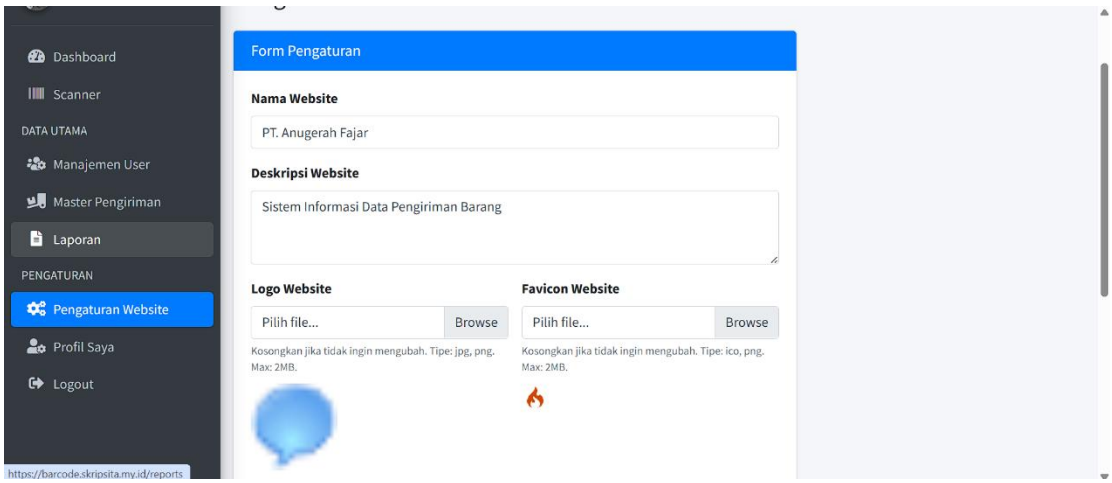

Figure 9. Website Settings Page

3.2. Discussion

The implementation of a web-based shipment information system integrated with barcode technology at PT. Anugerah Fajar demonstrates a significant improvement in the management of goods delivery processes. The results indicate that the developed system successfully addresses key operational challenges previously encountered in the manual shipment recording process, particularly in terms of data accuracy, processing speed, and information transparency. By replacing handwritten records and spreadsheet-based data entry with automated barcode scanning, the system minimizes human errors and ensures consistency in shipment data across different operational stages.

From an operational efficiency perspective, the barcode-enabled scanning feature plays a crucial role in accelerating shipment data input and status updates. Field personnel are able to update shipment information in real time simply by scanning the barcode attached to each item, reducing the time required for manual input and verification. This real-time data update capability enhances visibility throughout the delivery process, allowing administrators to monitor shipment status more effectively and respond promptly to operational issues such as delays or route deviations. Compared to the previous manual system, the new system provides faster access to accurate shipment information, which is essential for improving service responsiveness.

The dashboard feature further supports managerial decision-making by presenting shipment statistics, delivery trends, and status distributions in a concise and visual format. This functionality enables administrators to quickly identify patterns, such as peak delivery periods or frequently delayed shipments, which were difficult to detect using manual reports. The availability of structured and up-to-date information enhances the organization's ability to evaluate logistics performance and implement data-driven improvements. As a result, the system contributes not only to operational efficiency but also to strategic planning in logistics management.

User management functionality also strengthens system security and accountability. By implementing role-based access control, the system ensures that only authorized users can access or modify shipment data according to their responsibilities. This feature reduces the risk of unauthorized data manipulation and supports traceability by recording user actions within the system. Such control mechanisms are particularly important in logistics environments where data integrity and accountability directly impact service reliability and customer trust.

In terms of documentation and reporting, the system provides a structured reporting module that allows users to generate shipment reports based on specific time periods. The ability to export reports in PDF format simplifies documentation, archiving, and auditing processes that were previously time-consuming when performed manually. This improvement enhances compliance with administrative requirements and supports more transparent logistics operations. The reporting feature also facilitates performance evaluation by providing historical shipment data that can be analyzed for continuous improvement.

The use of the Rapid Application Development (RAD) methodology proves effective in ensuring that the system meets user requirements. Continuous user involvement during the development process allows feedback from administrators and field personnel to be incorporated into system refinements. This iterative approach results in a system that is not only technically functional but also aligned with actual operational workflows. The flexibility of RAD enables rapid adjustments to system features, contributing to higher user acceptance and system usability.

Despite these advantages, the system still has certain limitations. The current implementation relies on one-dimensional (1D) barcode technology, which has limited data capacity and requires physical visibility for scanning. Environmental factors such as barcode damage or poor lighting conditions may affect scanning accuracy. Additionally, the system's performance is dependent on network connectivity, which may limit real-time updates in areas with unstable internet access. These limitations suggest opportunities for future enhancements, such as integrating two-dimensional (2D) barcodes or QR codes, offline data synchronization, or complementary technologies like RFID for automated tracking.

Overall, the findings of this study confirm that integrating barcode technology into a web-based shipment information system can significantly improve logistics operations in a distribution company. The system enhances efficiency, accuracy, transparency, and accountability in shipment management, while supporting better customer service through timely and reliable information. These results are consistent with previous studies that highlight the effectiveness of barcode-based systems in logistics and inventory management, reinforcing the relevance of this approach as a practical and scalable solution for modern logistics environments.

4. CONCLUSION

This study concludes that the implementation of a web-based shipment information system integrated with barcode technology at PT. Anugerah Fajar has successfully improved the efficiency and accuracy of goods delivery data management. The use of barcode scanning significantly reduces manual data entry errors and accelerates the process of recording and updating shipment information. As a result, shipment data can be monitored in real time, providing better visibility and control throughout the delivery process.

The developed system also enhances transparency and accountability in logistics operations by providing structured documentation, comprehensive reporting features, and role-based user access control. These

functionalities support effective monitoring, auditing, and managerial decision-making, which were previously difficult to achieve using manual systems. The dashboard and reporting modules enable administrators to analyze shipment performance more effectively and support data-driven logistics management.

Furthermore, the application of the Rapid Application Development (RAD) methodology proves to be effective in producing a system that aligns with user requirements and operational workflows. Continuous user involvement during system development contributes to high system usability and acceptance. Although the current implementation utilizes one-dimensional barcode technology and relies on stable network connectivity, the system demonstrates strong potential for further enhancement through the integration of advanced identification technologies and offline capabilities.

Overall, this research demonstrates that barcode-based information systems represent a practical and scalable digital solution for improving logistics management in distribution companies. The findings contribute to the field of information systems and logistics by providing emspirical evidence of how barcode technology can be effectively integrated into web-based applications to support modern, efficient, and reliable shipment management.

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