
Development of an Web-Based Order Management System for Tailoring Businesses with Production Monitoring and WhatsApp Notifications

Muhammad Afwa Nawafal^{1*}, Indyah Hartami Santi¹, Udkhiati Mawaddah¹

¹ Islamic University of Balitar, Faculty of Information Technology, Informatics Engineering, Imam Bonjol Street No. 16, Jl. Majapahit No. 2-4, Sananwetan, Sananwetan District, Blitar City, East Java 66137, Indonesia

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*Corresponding Author:

jinnori7692@gmail.com

Abstract

Tailoring businesses, such as Anita Modiste Boutique, often face operational bottlenecks due to reliance on manual record-keeping for order processing and production monitoring, which leads to data inconsistencies, communication delays, and inefficient decision-making. This study proposes an integrated digital workflow model to modernize these operations, developed through the Rapid Application Development (RAD) methodology to ensure system alignment with administrative needs. The research contributes a novel approach by integrating customer order management, down payment tracking, and real-time internal coordination via an automated WhatsApp Gateway, serving as an active coordination mechanism between production staff and the boutique owner. The system's functionality was verified with an 84.62% success rate in initial Black Box testing, followed by 100% compliance after iterative refinements, while its acceptance was empirically validated via User Acceptance Testing (UAT) involving 61 respondents, resulting in a User Satisfaction Index (USI) score of 89.44% ("Excellent"). These findings demonstrate that digitizing internal coordination, beyond mere customer-facing administration, is critical for enhancing the operational performance and transparency of MSMEs, providing a functional and user-accepted digital solution for tailoring businesses.

1. Introduction

Small-scale tailoring businesses generally manage customer orders through manual procedures, particularly for recording order data, monitoring production progress, and preparing transaction reports. Similar conditions have been reported in previous studies, where manual management in tailoring businesses caused difficulties in storing, retrieving, and managing customer order information [1], [2]. This condition also occurs at Anita Modiste Boutique, where order and transaction records are maintained using notebooks or simple note-taking applications that are not specifically designed to support an integrated order management system. Although this approach is sufficient when the number of orders is limited, it becomes less effective as the volume of orders increases during peak periods.

Manual record management can lead to several problems, including data inconsistency, recording errors, difficulties in searching historical data, and inefficient report preparation [3]. In addition, monitoring customer order progress becomes challenging because the owner must directly contact employees to obtain production updates. This condition may cause delays in decision-making and differences between recorded information and the actual production status. Previous studies have demonstrated that implementing web-based

information systems can improve data management efficiency and reduce errors compared with manual processes [4].

Besides order management, tailoring businesses also require the management of supporting data, such as clothing categories, designs, materials, sizes, and colors. When these data are stored separately from customer order information, employees need to repeatedly record or search for similar information during the ordering process, which can reduce operational efficiency and increase the possibility of data inconsistency [2], [5].

As a made-to-order tailoring business, each customer order requires detailed specifications and continuous monitoring throughout the production process. However, manual monitoring methods limit the owner's ability to track production progress in real time, especially when the owner is not present at the boutique. Therefore, an integrated web-based order management system is needed to manage customer orders, down payment (DP) transactions, production status, and reporting within a single platform [5].

To improve internal communication, the proposed system incorporates an automated WhatsApp notification feature that sends production status updates from employees directly to the boutique owner. WhatsApp was selected because it is the primary communication platform used in the boutique's daily operations. Previous studies have shown that WhatsApp Gateway integration can support automatic notification delivery and improve the effectiveness of information dissemination in information systems [6],[7].

The system was developed using the Rapid Application Development (RAD) methodology because it emphasizes iterative prototyping, rapid development, and active user involvement, allowing developers to adapt the system according to user requirements[8]. This approach is suitable for Anita Modiste Boutique because the owner and employees can participate directly in requirement identification and prototype evaluation throughout the development process. Furthermore, the Laravel framework was utilized as the development framework to support structured and efficient web application development.

Previous studies have demonstrated that web-based order management systems can improve administrative efficiency in small and medium-sized enterprises by supporting digital order recording, transaction management, and centralized customer data management. These systems reduce dependency on manual documentation, minimize recording errors, and improve data accessibility for business owners and employees [9],[10].

Production monitoring has become an important component in manufacturing-oriented information systems because it enables businesses to observe work progress, analyze production status, and support timely decision-making. Recent studies have demonstrated the use of real-time monitoring approaches to improve production visibility, process control, and operational responsiveness [11],[12]. However, these studies primarily focus on monitoring production processes within manufacturing environments, rather than integrating production status monitoring with customer order management in a small-scale tailoring workflow.

The integration of WhatsApp Gateway has been increasingly implemented in information systems to provide automated notifications and improve communication efficiency. Previous research has demonstrated its use for delivering automated information and status notifications to system users [13],[14],[15]. However, the reviewed studies primarily address notification delivery as a communication function, while limited attention has been given to using WhatsApp Gateway specifically for internal coordination between employees and business owners in production-oriented workflows.

Although previous studies have addressed web-based order management, production monitoring, and WhatsApp-based notification as individual functions, limited attention has been given to integrating these functions within a single workflow. In particular, existing studies do not explicitly combine customer order management, down payment recording, production status monitoring, and automated internal communication between employees and business owners within a single web-based system designed for small-scale tailoring businesses [16].

The main contributions of this study are twofold. First, it proposes an integrated workflow that combines customer order management, production monitoring, and internal communication within a web-based system for small-scale tailoring businesses. Second, it implements automated WhatsApp notifications to support operational coordination between employees and the boutique owner. To validate the developed system, Black Box testing was conducted for functional verification, while User Acceptance Testing (UAT) utilizing the User Satisfaction Index (USI) was employed to assess user acceptance and perceived usability within the boutique's operational environment.

2. Research Method

Rapid Application Development (RAD) is a software development methodology that emphasizes rapid application development through iterative prototyping, continuous user involvement, and frequent feedback during the development process. Originally [17], RAD enables developers to respond more effectively to changing user requirements while reducing the overall development time compared to traditional models. According to Pressman [8], RAD emphasizes short development cycles and rapid development of working software. These characteristics are consistent with the iterative prototyping and frequent user validation required in this study.

In this study, RAD was selected based on the characteristics of the proposed system. The project had a focused scope and was developed for a small-scale tailoring business, with the boutique owner and production employees available to provide direct feedback during development. The system requirements were initially identified through observation and interviews but required repeated validation during the design and development process. These characteristics were consistent with the iterative and user-involved nature of RAD.

Previous comparative research indicates that RAD and prototyping are more suitable for customized software, whereas Waterfall is more appropriate for generic systems with relatively stable requirements [18]. Although Agile or Scrum also supports iterative development and user feedback, RAD was selected because this study emphasized rapid prototype refinement and direct validation with a small group of users. The RAD workflow adopted in this study, consisting of Requirements Planning, System Design, System Development, and System Implementation, is illustrated in Figure 1.

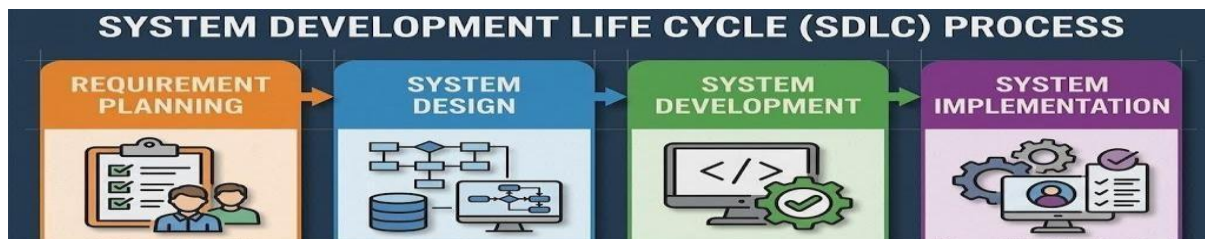


Figure 1. Rapid Application Development Model

The requirements planning phase aimed to identify system problems and user requirements. Following standard system analysis principles [19], data were collected through observation, interviews, and literature review. Observation was conducted to examine the existing business processes at Anita Modiste Boutique, while interviews with the boutique owner and employees were carried out to identify operational bottlenecks. Based on these data, the functional requirements were formulated, including customer order management, DP transactions, and automated WhatsApp notifications.

The system design phase translated the identified requirements into a comprehensive architectural model. To ensure data integrity and structural efficiency, the database system was designed using a relational data model (ERD) following the guidelines established [20]. The design focused on formulating an integrated digital workflow that connects customer order processing with real-time data synchronization via the WhatsApp Gateway API, ensuring seamless automated notifications.

The system was implemented as a web-based application utilizing the Laravel framework. The adoption of Laravel is justified by its robust Model-View-Controller (MVC) architecture, which accelerates development and provides high security for web applications [21]. In accordance with the RAD methodology, iterative refinements were continuously executed. The system's functional verification was conducted using Black Box testing. This testing method is universally recognized as an effective technique to validate whether all integrated features, particularly the automated notification triggers, operate according to specified inputs without technical anomalies [22].

Finally, the system evaluation phase was conducted directly at Anita Modiste Boutique to systematically evaluate the developed system. User Acceptance Testing (UAT) was conducted with respondents comprising the boutique management, production employees, and active customers. The evaluation utilized a standard five-point Likert scale questionnaire, which has been widely used in scientific research to quantify user perceptions and attitudes [23]. The collected data were subsequently analyzed using the User Satisfaction Index (USI) to evaluate the level of user acceptance of the developed system.

3. Result and Discussions

3.1 Requirements Analysis Results

The requirement analysis was conducted based on observations, interviews with the boutique owner and employees, and a literature review. The analysis revealed that Anita Modiste Boutique still relied on manual procedures for recording customer orders, monitoring production progress, and preparing transaction reports. Customer information and production status were recorded in notebooks, making data retrieval difficult and increasing the risk of recording errors and data inconsistency.

Interview results indicated that the boutique owner required an integrated information system capable of managing customer orders, recording down payment (DP) transactions, tracking production progress, generating automatic reports, and providing real-time notifications through WhatsApp. In addition, employees expected a system that could simplify order management and reduce repetitive manual data entry.

Based on these findings, the proposed system was designed to support six main functional requirements: user authentication and role-based access control, order management, production status management, automated WhatsApp notifications, automatic report generation, and system configuration. These requirements served as the foundation for the design and implementation of the web-based ordering system.

Table 1. requirement analysis result

No	Functional Requirement	Description
1	Order Management	Record and manage customer orders
2	Production Status Management	Update production progress
3	Automatic Report Generation	Generate transaction reports
4	WhatsApp Notification	Send production status notifications
5	Role-Based Access Control	Support owner and employee access

3.2 System Design Results

The system design was developed based on the functional requirements identified during the requirements analysis phase. The proposed system was designed to support the complete order management process at Anita Modiste Boutique, including customer order registration, down payment (DP) recording, production status management, automatic report generation, and WhatsApp notifications for real-time communication between employees and the boutique owner. The use case diagram illustrates the functional requirements and user-system interactions of the Anita Modiste Web-Based Order Management System. The system involves two internal actors, namely Employee and Owner, who interact with several core functionalities within the system boundary, including Login, Claim Order, Manage Order, Manage Production Status, Generate / View Reports, Manage Users & Access Roles, Manage Bank Accounts, and Manage Application Settings. Furthermore, the "Manage Production Status" use case includes an automated relation to "Send WhatsApp Notification," which

connects to the external WhatsApp Gateway actor.

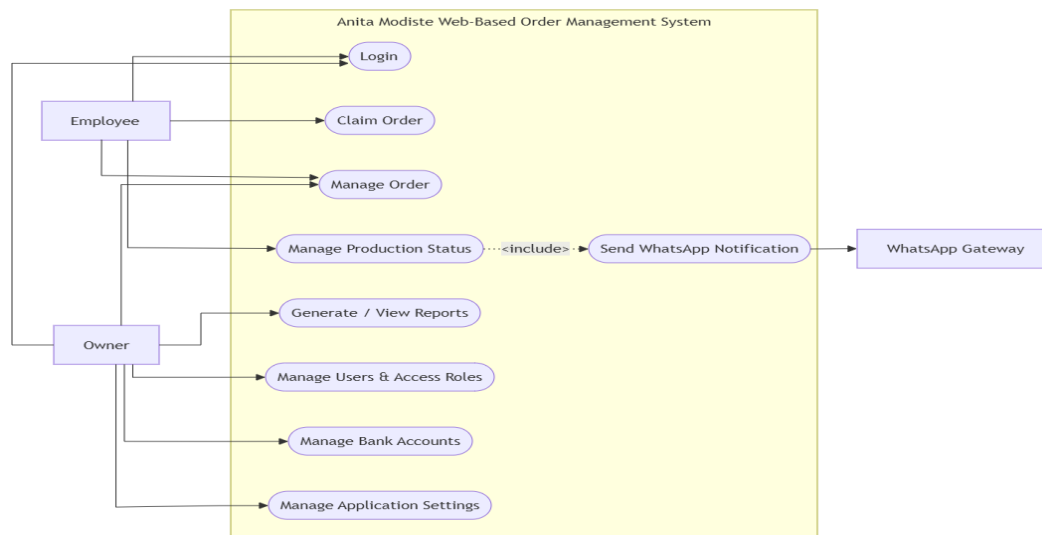


Figure 2. Use Case Diagram

Figure 3 illustrates the overall workflow of the proposed system. The process begins with user authentication, followed by customer and order data entry, down payment validation, and order management. Employees can subsequently update the production status of each order, while the system automatically sends WhatsApp notifications to the boutique owner whenever the production status changes. The recorded transaction data are then used to generate daily and monthly reports.

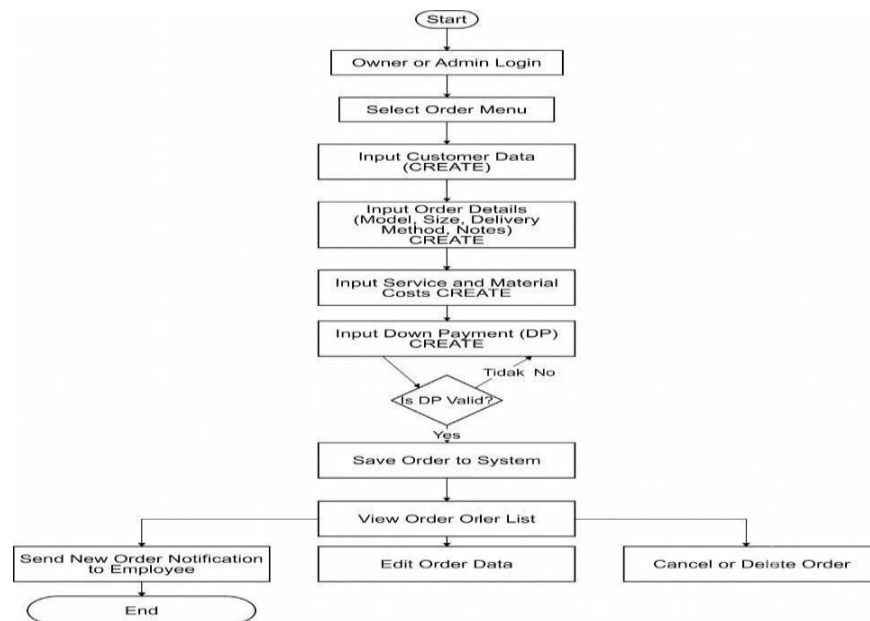


Figure 3. Flowchart Application

The Level 0 DFD in figure 4, provides an overview of the entire system and illustrates its interactions with external entities. The system is represented as a single main process, namely the Boutique Sales Information System, which interacts with two external entities: the Owner and Employees. The Owner provides operational and management data, including order, transaction, payment, user, cash and bank account, supplier, and

report-period requests, while receiving order, transaction, order archive, and report information. Employees provide new order data and sewing status updates based on production progress and receive work lists and validated sewing status information to support their production tasks.

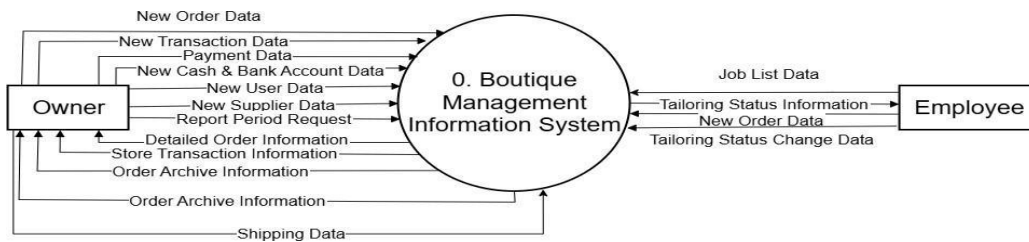


Figure 4. DFD level 0

DFD Level 1 in figure 5 illustrates the data flows and main processes of the Anita Modiste Boutique Order Management System in greater detail than DFD Level 0. The system is divided into five core processes that interact with the owner, employees, and databases, while customers are excluded as they do not directly interact with the system. These processes consist of Product Ordering, which manages order data, including customer details, measurements, design descriptions, pricing, down payments, and tailor assignment; Transaction, which manages accounts receivable and payable, including customer payments, bill payments, and corresponding cash balance updates; Archive, which manages order records based on tailoring progress and enables the owner to print PDF invoices; Report, which generates financial reports, cash books, transaction histories, and PDF documents based on stored transaction, archive, and shipping data; and Configuration, which manages supporting data such as bank accounts, user profiles, and supplier information.

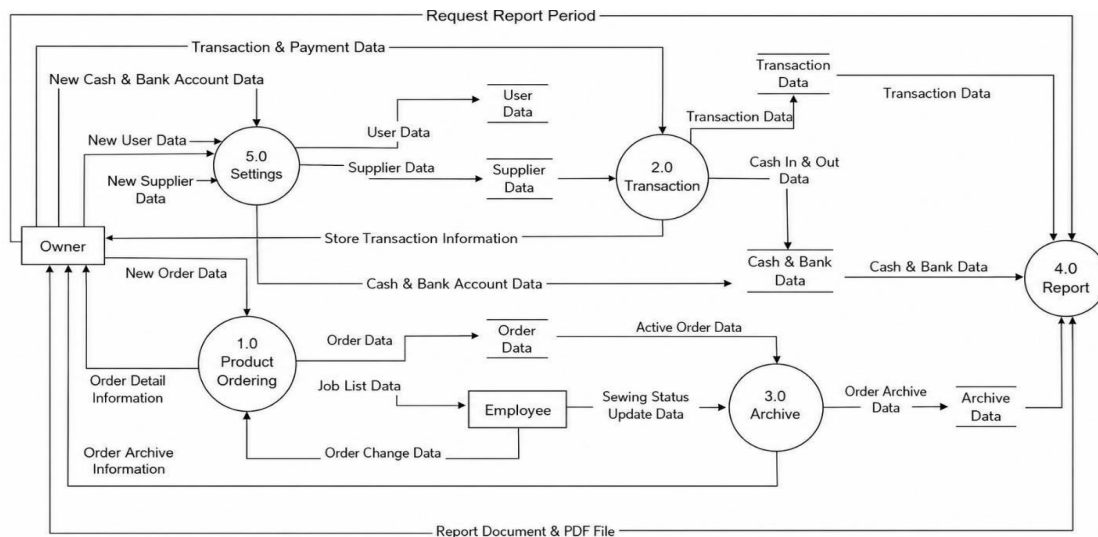


Figure 5. DFD level 1

Based on the designed Entity Relationship Diagram (ERD) in figure 6, the system consists of seven main entities: Employee, Owner, Product, Transaction, Transaction Detail, Bank Account, and Report, which are interconnected to support transaction management and reporting at Anita Modiste Boutique. The Employee entity stores employee data, including employee ID, name, username, password, and role, which are used for authentication and recording employee transactions. The Owner entity stores the boutique owner's information, including owner ID, name, username, password, and role, with full access to system data management and transaction records. The Product entity stores product information, including product ID, name, code, price, stock, and image, which serves as the basis for sales transactions.

The Transaction entity stores transaction data, including transaction ID, transaction date, total payment, and employee ID as a foreign key, and provides data for reporting. The Transaction Detail entity stores product details for each transaction, including detail ID, transaction ID, product ID, quantity, unit price, and subtotal, and links the Transaction and Product entities. The Bank Account entity stores the boutique's bank account information, including bank ID, bank name, account number, and account holder name, which is used for non-cash payment references and transaction records. Finally, the Report entity stores transaction summaries for specific periods, including report ID, period, total sales, profit, and loss, which are used by the owner for business evaluation and decision-making.

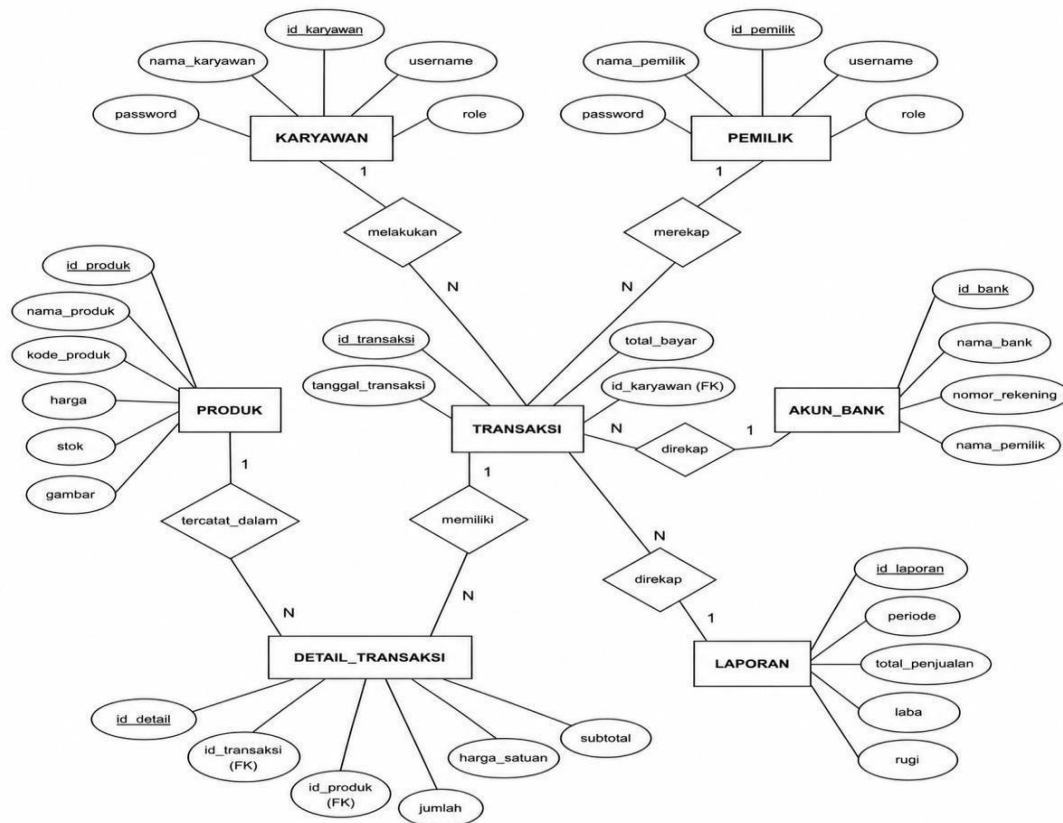


Figure 6. ERD

3.3 System Implementation

The implementation stage involved deploying the developed ordering information system at Anita Modiste Boutique Srengat to support the management of order data, down payment transactions, production status, and WhatsApp notifications. This stage aimed to ensure that the system could operate according to the designed functionalities and support the boutique's operational processes.

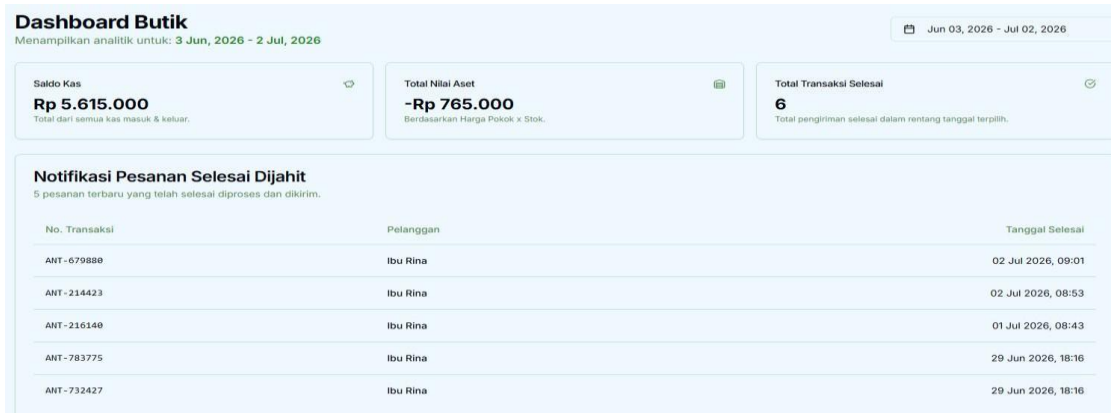


Figure 7. Dashboard

This page provides a summary of boutique operational conditions within a selected period. The dashboard includes a date range filter that allows owners to view operational analytics based on specific periods. It displays key information such as cash balance, total asset value, and completed transactions. Additionally, the dashboard provides a sewing completion notification feature that shows recently completed orders along with transaction numbers, customer names, and completion dates to assist owners in monitoring order follow-up processes.

Buat Pesanan Baru

No. Pesanan: **ANT-833626** | Nama Pelanggan: **Ibu Rina** | Pengambilan: **Dikirim Kurir Toko**

Jarak Kirim (km, Maks 30): **30**
Ongkir: Rp 30.000

UKURAN BADAN (CM)

LD: 140	LP: 120	PANJANG PUNGUNG: 0	L BAHU: 0
P LENGAN: 0	LINGKAR HIP: 0	TINGGI HIP: 0	P BAWAH: 0

MODEL / DETAIL LAINNYA: **merah**

DAFTAR JAHITAN Tambah

JML	HARGA (RP)
1	290000

Subtotal: Rp 290.000

Uang Muka (DP): **200000** | Diterima Di Akun: **Kas Tunai**

Total Jasa: **Rp 290.000**
Ongkir (30 km): **Rp 30.000**

Batal **Simpan Pesanan**

Figure 8. Transaction Form

The transaction form page is used to record new customer orders. It provides a structured input form containing order numbers generated automatically by the system, customer data, body measurements, and sewing item details. Users can add multiple items with descriptions, quantities, and prices, while the system automatically calculates subtotals and the total order cost. This page helps organize order recording, reduce input errors, and improve administrative efficiency.

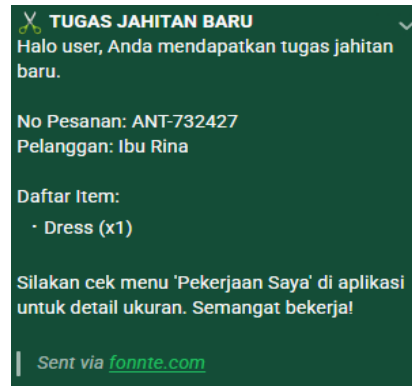


Figure 9. Whatsapp Notification for New Orders

Figure 6 Shows the notification of a new sewing task successfully sent through WhatsApp. This indicates that the WhatsApp Gateway integration functions properly to support information delivery to tailors.



Figure 10. Order Acceptance Page

Shows the order acceptance page, which allows authorized users to select available orders for sewing tasks. The system displays available orders and automatically transfers claimed orders to the user's task list to prevent duplicate assignments and improve work management efficiency.

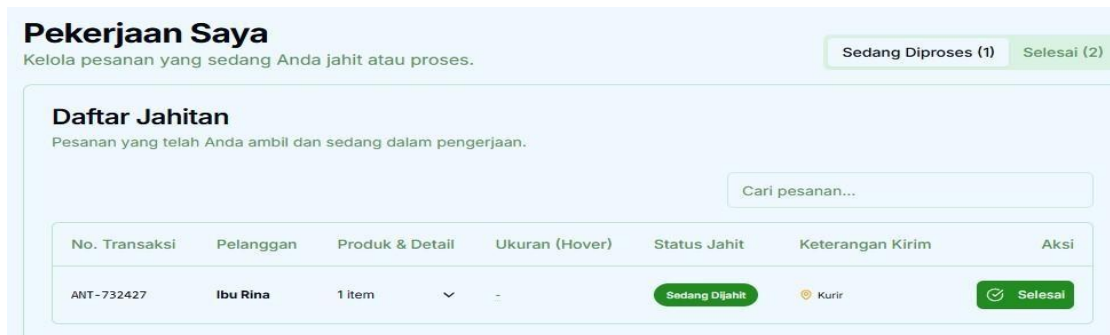


Figure 11. Order Completion Page

Order Completion page is used by tailors to view and manage assigned sewing tasks. Unlike the Order acceptance page, this page only displays orders that have been accepted by the respective tailor. The page consists of two sections: "In Progress," which shows ongoing sewing tasks with an option to update the status as completed, and "Completed," which stores finished orders as a work history record. This feature helps tailors manage their tasks and ensures that sewing progress is recorded systematically.



Figure 12 Notification for Completed Sewing Orders

shows the sewing completion notification received by the boutique owner via WhatsApp. The notification is automatically sent when the tailor updates the sewing status to completed, demonstrating that the system successfully supports real-time information delivery regarding order completion

3.4 System Evaluation

The developed ordering information system was evaluated to determine its functionality and user acceptance in supporting the operational activities of Anita Modiste Boutique Srengat. The evaluation was conducted using Black Box Testing to assess system functionality and Beta Testing to measure user acceptance of the implemented system.

Table 2. Black Box Testing

No.	Feature Tested	Test Scenario	Expected Result	Test Result	Conclusion
1	Login	Valid username and password	The system displays the dashboard based on the user's access role.	The dashboard was successfully displayed according to the user's access role.	Successful
2	Login	Invalid username or password	The system rejects the login attempt and displays an error message.	The system correctly Displayed an error message.	Successful
3	Order Management	Add a new order	The order data are saved and displayed in the order list.	The order was successfully saved and displayed.	Successful
4	Order Management	Update an existing folder	The modified order data are saved successfully.	The update order was successfully saved.	Successful
5	Order Claim	Claim an available order	The order is assigned and can not be claimed by another employee.	The order was successfully claimed and locked.	Successful
6	Production Status Management	Update the status to Not Started or In Progress	The production status is updated successfully.	The production status was successfully updated.	Successful
7	Production Status Management	Progress Update the Status to Completed	The production status is updated successfully.	The production status was successfully updated.	Successful

8	Management WhatsApp Notification	Completed Update the production status	A WhatsApp notification is sent to the boutique owner.	The notification was successfully sent, although a slight delay occasionally occurred.	Successful
9	Reporting	Select a reporting period	The report is generated based on the selected period.	The report was successfully generated according to the selected filter.	Successful
10	User Management	Add a new user	The user data are saved successfully	The user data were successfully saved.	Successful
11	User Management	Update user access role	The user access role is updated successfully.	The access role was successfully updated.	Successful
12	Bank Account Management	Add a bank account	The bank account data are saved successfully.	The data were saved successfully, but the page required a manual refresh to display the changes.	Failed
13	Application Settings	Update application settings	The updated settings are saved successfully.	The settings were saved successfully, but the interface required a page reload to reflect the changes.	Failed

Functional verification was performed using Black Box testing [22] covering 13 core scenarios, The success rate was calculated using the following formula:

$$Success\ Rate = \left(\frac{\sum Passed\ Scenarios}{\sum Total\ Scenarios} \right) \times 100\ \% \quad (1)$$

Table 3. Re-testing Results After Iterative Refinement

No.	Feature Tested	Test Scenario	Re-test Result	Conclusion
1	Bank Account Management	Add a bank account	The bank account data were successfully saved and immediately displayed without requiring a manual page refresh.	Successful
2	Application Settings	Update application settings	The updated settings were successfully saved and immediately reflected in the interface without requiring a manual page reload.	Successful

The testing yielded an 84.62% success rate. The two identified issues in the application settings were immediately addressed and rectified during the iterative development cycle, ensuring that the final deployed version achieved 100% functional compliance. This iterative process highlights the effectiveness of the RAD methodology in identifying and resolving technical anomalies early in the development phase.

Table 4. UAT Result

No.	Evaluation Item	Score (%)
1	The system interface is visually appealing.	90.16
2	The menu layout is easy to understand.	90.82
3	The system is easy to use without special guidance.	87.54
4	The system operation is easy to learn.	83.61
5	System features function as expected.	86.89
6	The system improves work efficiency.	89.51
7	The system operates reliably with minimal errors.	87.21
8	The information generated by the system is accurate.	93.11
9	The system is beneficial for daily operations.	94.75
10	Overall, I am satisfied with the system.	90.82

The system's usability and acceptance were evaluated through User Acceptance Testing (UAT) involving 61 respondents using a five-point Likert scale. The respondents consisted of one boutique owner, five production employees, and 55 active customers. The owner and production employees represented the system's primary user roles, while the active customers participated as stakeholders and evaluators rather than as direct system users. Before completing the questionnaire, the active customers were provided with a direct demonstration of the application and an explanation of its workflows and usage scenarios to enable them to evaluate the system based on its demonstrated interface and functionality. The UAT results are presented in Table 4 and were analyzed using a normalized Likert scoring approach to calculate the overall User Satisfaction Index (USI):

$$USI = \left(\frac{\sum S}{N \times I \times R} \right) \times 100\% \quad (2)$$

Where:

$\sum S$ = Total obtained score from all respondents,

N = Maximum Likert scale score (5),

I = Number of evaluation indicators (10),

R = Number of respondents (61).

Table 5. User Satisfaction Index

No	Category	Percentage (%)
1	Very Poor	<21
2	Poor	21-40
3	Fair	41-60
4	Good	61-80
5	Excellent	81-100

The resulting overall USI score was 89.44%. As categorized in Table 5, this score falls within the "Excellent" range (81%–100%). The highest scores were obtained for "The system is beneficial for daily operations" (94.75%) and "The information generated by the system is accurate" (93.11%), indicating positive respondent perceptions of the system's practical benefits and information accuracy. Overall, these results indicate a high level of user and stakeholder acceptance of the developed system. However, the overall USI score should be interpreted within the context of the respondent composition, as 55 of the 61 respondents were active customers who evaluated the system as stakeholders rather than direct users. Therefore, the result primarily reflects the aggregated perceptions of the participating respondents and should not be interpreted as a direct measure of operational improvement or as equally representative of all user roles. Within this case study, the findings provide support for the applicability of the integrated workflow model to the administrative and operational context of Anita Modiste Boutique.

3.5 Discussion

The evaluation results indicate that the developed system achieved satisfactory functional performance and user acceptance compared with other information systems developed for MSMEs. In the initial Black Box Testing, 11 of 13 scenarios were successfully executed, resulting in an 84.62% success rate. The two unsuccessful scenarios were related to the immediate display of updated bank account data and application settings. After iterative refinement, both scenarios were successfully re-tested, resulting in 100% functional compliance in the final version. This result is comparable to the digital printing ordering information system developed by Anwarri et al. [24], which also achieved a 100% success rate in Black Box Testing. Similarly, the PUMK information system reported that all tested functions operated successfully during Black Box Testing

[25]. These results indicate that the final version of the proposed system achieved a level of functional validity comparable to other web-based information systems developed for MSME-related operational processes.

The User Satisfaction Index (USI) obtained in this study was 89.44%, indicating a high level of user and stakeholder acceptance. This result is higher than the 86.8% UAT score reported for the digital printing ordering information system in [24] and the 88% UAT score reported for the PUMK information system in [25]. However, it is lower than the 95% UAT score reported for the MSME Marketplace information system in [26]. The differences in these results may be influenced by differences in system scope, evaluation instruments, respondent characteristics, and operational contexts. Therefore, the results should be interpreted as comparable evidence of user acceptance rather than as a direct ranking of system quality among the studies.

The relatively high USI score in this study can be associated with the integration of several functions into a single operational workflow, including order management, production status monitoring, transaction recording, reporting, and automated WhatsApp notifications. Similar to the systems in [24],[26],[25], the proposed system replaces manual processes with a web-based information system and provides structured access to operational data. However, the present system additionally connects customer orders with production task assignment and automatic WhatsApp notifications, allowing production status changes to be communicated to the boutique owner in real time. This integration is particularly relevant to the operational characteristics of a tailoring business, where order management and production progress are closely connected.

Despite the favorable USI result, the findings should be interpreted within the respondent composition of this study. Of the 61 respondents, only one boutique owner and five production employees represented the primary internal users, while 55 active customers evaluated the system as stakeholders rather than direct users. Therefore, the 89.44% USI reflects the overall perception of the participating respondents and should not be interpreted as a direct measurement of employee productivity or objective operational improvement. Nevertheless, the combination of 100% functional compliance after iterative refinement and an 89.44% USI provides evidence that the developed system is functionally reliable and positively accepted within the case-study environment.

4. Conclusions and Future Works

This study successfully developed and implemented an integrated web-based order management system for Anita Modiste Boutique, addressing operational inefficiencies inherent in manual record-keeping. The primary scientific contribution of this study lies in the proposed integrated workflow model, which bridges customer-facing administration and internal production tracking, a feature often neglected in conventional MSME information systems. By integrating order management and real-time production status updates through an automated WhatsApp Gateway, this research demonstrates a transition from manual administrative practices to a digitized operational framework.

The empirical evaluation consisted of Black Box testing for functional verification and User Acceptance Testing (UAT) using the User Satisfaction Index (USI). The initial Black Box testing achieved an 84.62% success rate, followed by 100% compliance after iterative refinements and re-testing. Meanwhile, the UAT, involving 61 respondents, achieved a User Satisfaction Index (USI) score of 89.44%, categorized as “Excellent.” These results indicate that the developed system provides a functional and user-accepted digital solution for the administrative and production-tracking needs of Anita Modiste Boutique within the context of this case study.

Despite these positive outcomes, this study acknowledges several limitations. The evaluation was conducted as a single case study, which may limit the generalizability of the findings to other tailoring businesses and larger manufacturing scales. Additionally, the current notification feature depends on the availability and stability of the third-party WhatsApp Gateway service, which may introduce potential risks such as service downtime and limited control over the notification infrastructure. Therefore, future research should address these limitations by conducting multi-site evaluations across different tailoring businesses to further validate the applicability and generalizability of the proposed integrated workflow model. Furthermore, future studies

should investigate and develop a self-managed notification mechanism that minimizes dependency on third-party gateway services. Such an approach could provide greater control over the notification infrastructure and reduce dependency on the availability of externally managed services.

5. Declarations

Author Contributions

M.A.N.: Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Data Curation, Writing – Original Draft, Writing – Review & Editing; I.H.S.: Supervision, Writing – Review & Editing; U.M.: Supervision, Validation, Writing – Review & Editing.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Data containing confidential business and respondent information are not publicly available.

Use of Artificial Intelligence (AI)

Generative AI tools were used as coding assistance during software development and for language editing during manuscript preparation. The authors reviewed and verified the AI-assisted outputs and take full responsibility for the content of the manuscript.

Ethical Clearance

This study was a low-risk information system development and evaluation study conducted at Anita Modiste Boutique. The evaluation involved business personnel and active customers who participated in User Acceptance Testing. No clinical intervention or animal subjects were involved. Formal ethical clearance was not obtained for this low-risk study. The research was conducted with permission from the business, with due consideration for the confidentiality of business and respondent data.

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