

Design and Development of a Website for Micro, Small, and Medium Enterprises (MSMEs) of Pekunden Pottery Craft Using the Extreme Programming Method

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Abstract

Background: The rapid growth of digital technology drives Micro, Small, and Medium Enterprises (MSMEs) to adopt information systems to improve competitiveness. Pekunden Pottery MSME in Pemalang Regency relies on conventional marketing, which limits its ability to expand market reach and manage sales effectively.

Aims: This study aims to design and develop a website for Pekunden Pottery MSME as a digital promotional platform, to facilitate online transactions, and to manage sales data effectively.

Methods: This study applied the Extreme Programming (XP) methodology through planning, design, coding, and testing phases. The researchers used Blackbox Testing to validate the functionality against user requirements.

Result: The developed website provides product promotion, online ordering, payment integration with Midtrans, and automated shipping cost calculation using the RajaOngkir API. Testing achieved a 97.29% success rate, confirming that the system meets functional requirements and operates reliably.

Conclusion: The system supports the digital transformation of Pekunden Pottery MSME by improving online visibility, simplifying sales management, and strengthening competitiveness. This research contributes academically by demonstrating the effective application of XP in MSME website development, while practically providing a model that enhances operational efficiency and business growth in the digital economy era.

A. Introduction

The rapid advancement of information technology has driven the transformation of the digital economy into a global trend in recent years. Technology has reshaped various aspects of human life, including the economic sector and business innovation (Mick et al., 2024). This transformation presents both opportunities and challenges for business actors, including Micro, Small, and Medium Enterprises (MSMEs) in Indonesia. To remain competitive, MSMEs are required to adapt through the utilization of the digital economy and product innovation to maintain their competitiveness in an increasingly dynamic market environment (Bahtiar et al., 2025). Technology-based innovation strategies have been proven to enhance business performance, expand market reach, and strengthen competitive positioning (Manalu et al., 2023).

Micro, Small, and Medium Enterprises (MSMEs) play a vital role in the national economy. According to data released by the Indonesian Chamber of Commerce and Industry (KADIN), the number of MSME actors in Indonesia reached about 66 million business units in 2023. These enterprises contribute to approximately 97% of total national employment and account for around 61% of the national Gross

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Domestic Product (GDP) annually. Similar findings have also been highlighted in international studies, which emphasize the critical role of MSMEs in sustaining employment and GDP contribution across emerging economies (Egala et al., 2024; Petropoulou et al., 2024). The increasingly competitive technological era, as reflected in the resilience and consistent growth of MSMEs despite disruptions during the COVID-19 pandemic, further demands continuous innovation to engage digitally connected consumers (Abidi et al., 2023).

Technological advancements have also influenced consumer behavior, where society has become increasingly accustomed to conducting transactions online. This condition creates opportunities for MSMEs to leverage technology as a medium for broader product promotion and sales (Alkhasoneh et al., 2025; Figueiredo et al., 2025). Digital marketing is recognized as an effective strategy as it allows online product promotion through digital media and direct interaction with customers, such as via social media and e-commerce platforms (Armiani, 2024; Fadillah et al., 2025). The adoption of digital technology also enables MSMEs to design more efficient marketing strategies, reach new customer segments, and strengthen customer loyalty (Faiz et al., 2024).

Nevertheless, not all MSMEs are able to maximize the use of technology. One such example is the Pekunden Pottery MSME, located in Pemalang Regency. Based on an interview with the head of the Pekunden Pottery Association on May 12, 2024, it was revealed that product marketing still relies on conventional methods, such as WhatsApp status updates, consigning products to markets, and word-of-mouth dissemination. This has limited the customer base and hindered business growth. Moreover, the absence of structured sales reports has resulted in suboptimal business strategy management.

A similar case occurred with two batik entrepreneurs in Pilang Village, Masaran District, who went bankrupt due to their inability to adapt to technological developments and their continued reliance on conventional marketing methods, as reported by Radar Solo Jawa Pos (January 6, 2022). In contrast, Beni Santoso, owner of “IniTempe” from Bali, successfully saved his business from bankruptcy by implementing digitalization as a marketing strategy, enabling the business not only to survive but also to expand its market to customers outside the region according to a news report from Bisnis.com (July 30, 2022).

A preliminary survey involving 30 respondents revealed that most participants had difficulty accessing MSME product information online and emphasized the importance of having a website to support promotion, expand market reach, and build consumer trust. Based on these findings, there is a need for a web-based information system to facilitate product marketing and structured sales reporting. However, Pekunden Pottery MSME has not fully utilized digital platforms, which limits market reach, causes unstructured sales reporting, and weakens competitiveness.

Despite growing interest in MSME digital transformation, empirical studies applying XP in the context of traditional, resource-constrained MSMEs remain scarce. Commonly employed methodologies like Waterfall noted for its sequential and inflexible structure often struggle to adapt to dynamic market needs, while Scrum, although agile, requires structured roles such as Scrum Master and Product Owner that may be infeasible for small MSME teams (Legowo & Aditama, 2020; Putrianasari et al., 2024). In contrast, XP’s characteristic short iterations, frequent stakeholder feedback, and minimal documentation align better with the realities of MSMEs’ small teams, tight budgets, and evolving requirements (Hosen, 2022; Pratama et al., 2024).

Although previous studies have explored MSME digitalization, few have applied the XP methodology in MSME website development, and even fewer have integrated widely used local solutions such as Midtrans for secure online payments and RajaOngkir for shipping cost calculations (Arta et al., 2022; Kurniawan & Richi, 2024). This study adopts the XP methodology, chosen for its iterative and flexible nature, as well as its emphasis on continuous interaction with users to ensure that the resulting system meets actual requirements (Sihombing, 2024; Mantik & Sihombing, 2023). Midtrans was selected because it provides a secure and widely used payment gateway in Indonesia, while RajaOngkir offers a reliable API that supports multiple logistics providers, making it highly suitable for MSME operations. Therefore, this research not only aims to develop a technological solution in the form of a website to expand market reach and enhance the competitiveness of the Pekunden Pottery MSME in the digital era but also contributes academically by demonstrating the integration of XP with practical local solutions.

B. Research Methods

Extreme Programming (XP)

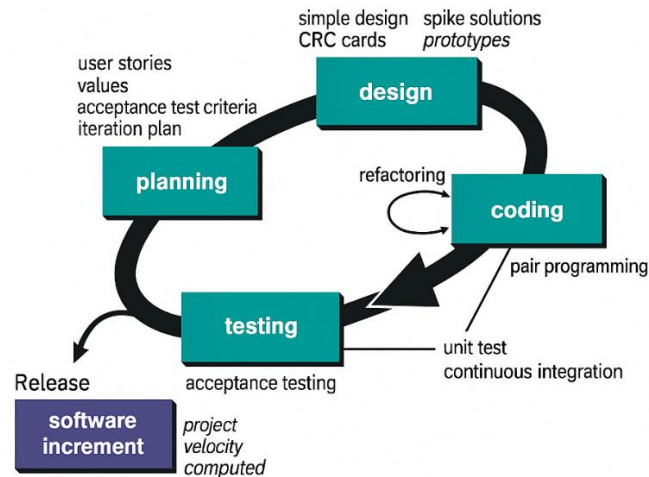


Figure 1. Extreme Programming Method

Extreme Programming (XP) is an Agile software development methodology that emphasizes flexibility, intensive communication, and short iterative cycles to deliver high-quality software. It is suitable for projects with small to medium-sized teams requiring rapid feature updates and is developed as an object-oriented approach that is responsive to user needs (Al Amin et al., 2024; Narahaba & Lee, 2024).

One of XP's key characteristics is active and continuous communication between developers and users, ensuring that each developed feature is directly validated to meet actual user requirements (Mohammed & Mesfin, 2020). Furthermore, XP promotes the adoption of simple design to avoid unnecessary complexity, enabling developers to focus on core functionality before expanding to additional features (Mite et al., 2024). The XP methodology consists of four core phases:

1. Planning

In Extreme Programming (XP), the planning phase is the initial stage aimed at identifying system requirements directly from users through discussions and collaboration. During this stage, developers and users work together to define the core problems, determine the essential features to be developed, and set priorities based on both business and technical needs. This process involves intensive communication between the development team and stakeholders to ensure a shared understanding of the system to be built, thereby aligning the development outcomes with the actual expectations and requirements of the users (Taftazani et al., 2024).

2. Design

In Extreme Programming (XP), the design phase focuses on creating a simple and easily understandable architecture, with the minimal number of classes and methods necessary to fulfill the required functionality. This simplicity allows the system to be comprehensible without extensive documentation and facilitates easy modifications without altering the core structure or primary functions. Such an approach ensures controlled development costs, maintains code quality, and enables developers to concentrate on implementing core functionalities rather than producing overly complex documentation (Shrivastava et al., 2021).

3. Coding

In Extreme Programming (XP), the coding phase is carried out after the completion of the design stage, where the interface layout and system workflow have been clearly defined. This ensures that developers have a solid reference before writing code. The implementation is performed incrementally, with each feature developed according to the priority set during the planning stage and immediately tested upon completion.

Pair programming is applied to improve code quality, minimize errors, and accelerate problem-solving. Unit testing is conducted in parallel with the coding process to verify the correctness and functionality of each component before integration. The process follows an iterative approach, allowing rapid adjustments to changing requirements during development without compromising the core architecture of the system. Overall, the coding phase in XP emphasizes speed, collaboration, continuous testing, and flexibility, aiming to deliver software that meets user requirements while maintaining high quality.

4. Testing

In Extreme Programming (XP), the testing phase is conducted immediately after each coding iteration to ensure that the developed functionalities align with the predefined requirements. This testing process is carried out continuously throughout the development cycle, rather than solely at the end of the project, allowing defects to be identified and corrected at an early stage (Anggraeni & Gustalika, 2025).

This study employs the Black Box Testing method, which focuses on verifying system functionality based on the inputs provided and the outputs produced, without inspecting or having prior knowledge of the underlying source code. Within the context of XP, this approach ensures that each developed feature meets user requirements and specifications by testing various input scenarios, including normal conditions, boundary cases, and error situations (Azizah et al., 2024).

Additional Implementation Details

The development process lasted for three months (12 weeks), structured into four main stages: planning (2 weeks), design (3 weeks), coding (5 weeks), and testing (2 weeks). The XP cycle was implemented in two iterations. In the first iteration, core modules such as user authentication, product catalog, and basic interface layout were developed and tested. In the second iteration, advanced features including transaction processing, sales reporting, and integration with Midtrans and RajaOngkir APIs were added, followed by refinement based on user feedback.

The development team comprised the researcher as the main developer and the academic supervisor as the product owner, who provided methodological guidance, evaluation, and validation of deliverables. Continuous feedback was obtained from representatives of the Pekunden Pottery MSME, who participated as end-user validators to ensure that functional requirements and usability aspects were adequately addressed.

System modeling was conducted using Draw.io for UML diagrams. Coding was implemented using React JS as the front-end framework and Firebase for backend services, including authentication, database management, storage, and hosting. Functional testing was performed using Black Box Testing, while integration of Midtrans (for secure payment) and RajaOngkir (for shipping cost calculation) was validated using Postman.

The success criteria for testing were defined as follows:

1. All functional test cases must match the expected output.
2. The error rate must not exceed 5% of the total test cases.
3. The system must operate stably on major browsers (Chrome, Firefox, and Edge) without critical failures.

C. Results and Discussion

1. Results

1.1. Planning

The planning phase began with the identification of system requirements through direct observation and interviews with artisans from the Pekunden Pottery MSME. The primary focus of this stage was to design a system that supports the operational activities of the enterprise, including online marketing, sales transactions, and efficient data management.

This phase emphasized a comprehensive understanding of both user and technical requirements. User requirements included ease of use for both administrators and customers, while technical requirements involved selecting an appropriate platform, technology stack, and system specifications. The ultimate goal was to develop a system that is both relevant and adaptive to the operational context of the Pekunden Pottery MSME.

a. System Functions

The web-based information system for the Pekunden Pottery MSME is designed to support digital business operations by enabling product promotion, integrated online transactions, and structured sales data management. The core functions of the system include:

1. Product Promotion

The system provides detailed product information, including descriptions, images, and pricing, to enhance product visibility and appeal in digital markets.

2. Integrated Online Transactions

The platform facilitates online ordering and payment through integration with Midtrans, and automatically calculates shipping costs using the RajaOngkir API, streamlining the purchasing process.

3. Sales Management

All transactions are recorded automatically, and the system generates comprehensive sales reports to help business owners monitor and evaluate business performance effectively.

4. MSME Profile Information

The website displays the business profile and contact information of the MSME operator, promoting transparency and fostering consumer trust.

5. User Interaction Features

The system provides customer accounts that allow users to track their orders, view transaction history, submit feedback, and receive automated notifications regarding order status updates.

b. User Requirements

User requirements define the essential functions and features needed to ensure that the system meets the expectations and operational needs of both administrators and consumers. These requirements were derived from direct observation and interviews with stakeholders at Pekunden Pottery SMEs.

Table 1. User Requirements Table

No	User Requirements
1.	Administrators must be able to manage product information easily, including adding, editing, and deleting product data.
2.	Administrators must be able to monitor and manage incoming orders through the website and update the status of each order.
3.	Administrators must be able to manage customer data, including the ability to delete records and contact customers when needed.
4.	Administrators must be able to generate and export sales reports based on selected date ranges and product categories.
5.	Administrators must have access to a dashboard that summarizes transactional data, customer statistics, product listings, and sales performance.
6.	Administrators must have secure access to the system through a protected login mechanism and role-based access control to ensure data confidentiality.

Table 2. Consumers Requirements Table

No	Consumer Requirements
1.	Consumers must be able to view a complete product catalog, including clear descriptions, prices, and images.
2.	Consumers must be able to purchase products online through a user-friendly ordering and payment process.
3.	Consumers must be able to easily view the status of their purchases and access their transaction history.
4.	Consumers must be able to contact the business through the contact information provided on the website

c. System Requirements

System requirements define the technical specifications that must be fulfilled to ensure proper system functionality. The following table outlines the system requirements based on user roles and functional needs:

Table 3. System Requirements Table

No	System Requirements
1.	The system must provide a secure login feature that differentiates access rights between administrators (admins) and consumers.
2.	The system must allow administrators to add, update, delete, and manage product information, including product name, description, price, and stock.
3.	The system must enable administrators to view and process incoming orders, and update order statuses.
4.	The system must store and manage customer data related to transactions, including purchase history, shipping address, and contact information.
5.	The system must generate sales reports based on specific time periods, product categories, and other business analysis parameters.
6.	The system should provide a dashboard displaying key metrics such as total orders, revenue, and visitor statistics.
7.	The system must enforce role-based access control to ensure that users can only access data and functionalities appropriate to their roles.
8.	The system should offer a product search and filtering feature to help consumers easily find desired items.
9.	The system must support a streamlined ordering process, including adding products to a shopping cart, entering shipping information, and confirming orders.
10.	The system must integrate with the Midtrans payment gateway and RajaOngkir shipping API to support various payment methods and automatic shipping cost calculations.
11.	The system must enable consumers to track the status of their orders in real time.
12.	The system should allow consumers to submit messages or reviews to the business administrator.

1.2. Design

Following the completion of the planning phase, the next stage involves system design, which encompasses the development of workflow diagrams, system architecture, user interface layouts, and database structure. System modeling is conducted using Unified Modeling Language (UML), with a focus on use case diagrams and activity diagrams to illustrate user interactions and system activity flows. Additionally, mockups of the user interface are created to provide a visual representation of user-system interactions. This design phase aims to ensure effective system integration and functional coherence prior to the implementation stage.

a. Use Case Diagram

The use case diagram illustrates the interactions between system actors administrators and customers and the website's core functionalities. It defines the primary actions performed by each user role, including product management, order processing, and transaction tracking. This diagram serves as a functional overview of the system and supports the identification of essential features to be implemented.

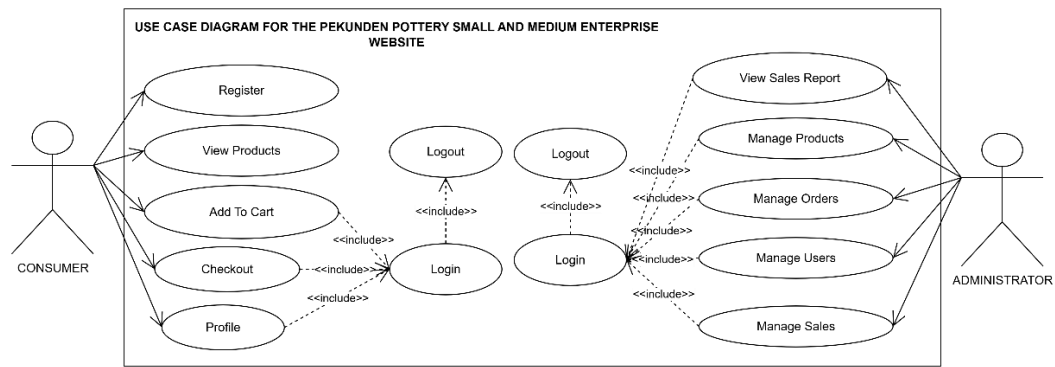


Figure 2. Use Case Diagram

The use case diagram describes interactions between two main actors: Administrator and Consumer. Consumers can register, log in, browse products, manage their profiles, add items to a cart, and proceed to checkout. Meanwhile, administrators are responsible for managing products, orders, users, and viewing sales reports. Both actors share access to login and logout functionalities. The use of <<include>> relationships denotes that certain actions (e.g., checkout, profile access) depend on successful authentication via the login process. This diagram ensures that all critical system functionalities and user roles are clearly identified prior to implementation.

b. Activity Diagram

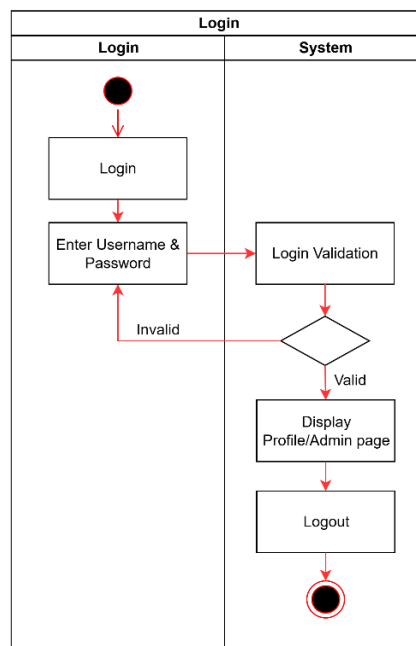


Figure 3. Login Activity Diagram

The login activity diagram presents the sequence of actions during the authentication process on the Pekunden Pottery MSME website. The process begins when the user accesses the login page and inputs their username and password. The system then validates these credentials. If the validation is successful, the user is redirected to the appropriate dashboard either the admin or profile page, depending on their role. If the credentials are invalid, the system returns the user to the login input screen. The process ends with a logout action, which terminates the session. This diagram emphasizes secure access control, error handling, and role-based redirection within the system.

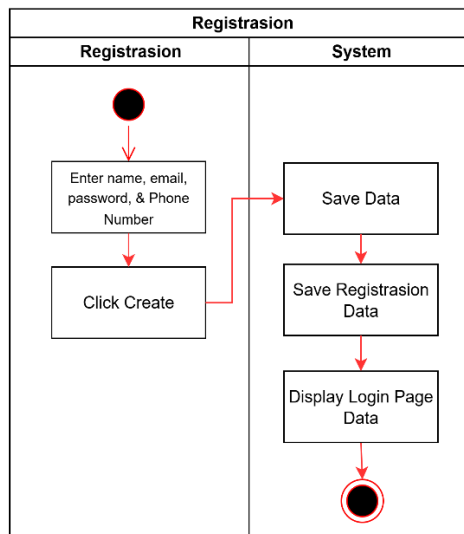


Figure 4. Register Activity Diagram

The registration activity diagram outlines the process a new user follows to create an account on the Pekunden Pottery MSME website. The user begins by entering their name, email, password, and phone number, then clicks the “Create” button to submit the registration form. The system receives and stores the input data, saving the registration information into the database. After successful data storage, the system redirects the user to the login page. This flow ensures that all user input is properly recorded and that the user is seamlessly guided toward the authentication process.

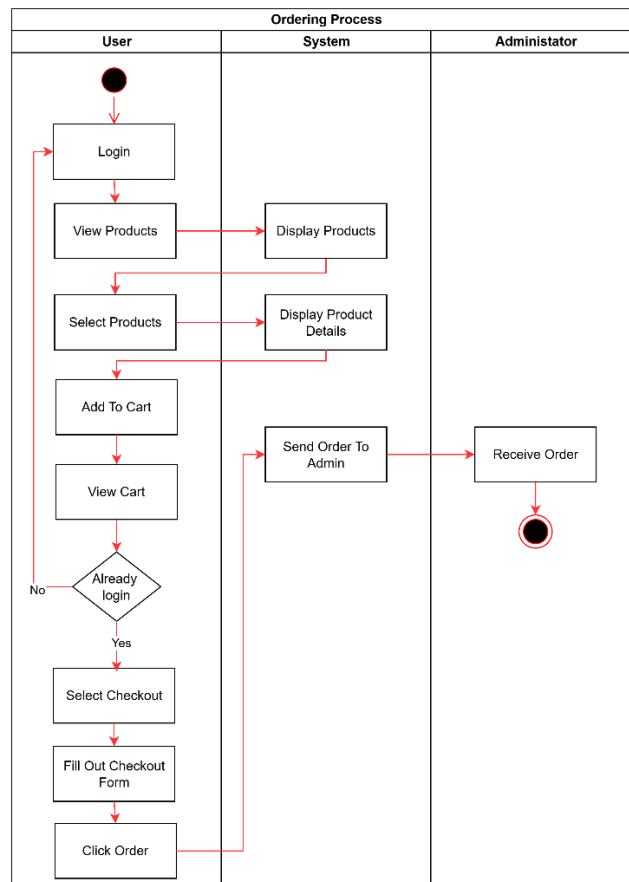


Figure 5. Orders Activity Diagram

The ordering activity diagram describes the complete sequence of actions a user follows to place an order on the Pekunden Pottery MSME website. The process starts when the user logs into the system and views available products. Upon selecting a product, the system displays detailed information. The user can then add the product to the shopping cart and review the cart contents. If the user is already logged in, they proceed to checkout; otherwise, the system prompts for login.

Next, the user fills out the checkout form with necessary shipping and payment details, then submits the order by clicking the “Order” button. The system forwards the order information to the admin, who receives and processes the order. This diagram illustrates the seamless integration between user interaction, system response, and admin notification to ensure efficient order processing.

1.3. Coding

The implementation phase involved the development of the Pekunden Pottery SMEs website using React.js as the front-end framework and Firebase as the backend and real-time database. React.js was selected due to its ability to support dynamic, responsive interfaces and streamline the rendering of UI components.

Firebase was utilized to provide backend functionalities, including user authentication and real-time data storage, enabling rapid development and seamless service integration. At this stage, all system components user interface, business logic, and third-party integrations such as Midtrans (payment gateway) and RajaOngkir (shipping API) were developed in alignment with the design specifications. Each feature was also tested during development to ensure functional correctness and user alignment.

a. Login and Register Page

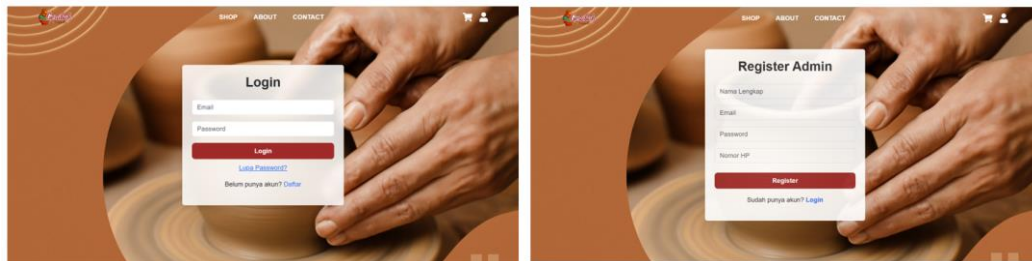


Figure 6. Login and Register Page

The figure illustrates the user interface of the login and registration pages for the Pekunden Pottery website system. The login page (left) requires users to input their registered email and password in order to access the system, with additional options for password recovery and registration redirection. The register page (right) enables new administrators to sign up by providing their full name, email, password, and phone number. Both pages utilize a responsive design with a consistent visual identity, featuring the pottery background as a thematic element to align with the brand identity of Pekunden Pottery SMEs. These interfaces aim to ensure ease of use and provide secure access control via role-based authentication.

b. User shopping page

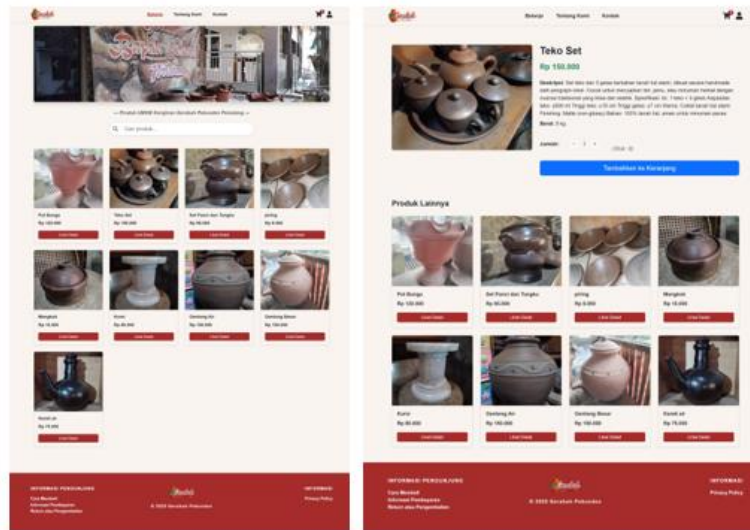


Figure 7. Product Catalog Page and Product Detail Page

The figure illustrates two main interfaces of the e-commerce section of the Pekunden Pottery website. The left side displays the product catalog page, where users can browse available pottery items including jars, teapots, stoves, and trays. Each product is presented with an image, name, and “Order Now” button. A search bar is provided to filter items based on keywords.

The right side shows the product detail page, featuring a comprehensive view of a selected product (e.g., "Teko Set"). It includes detailed product descriptions, pricing, size/weight info, available stock, and quantity selection. Users can add the product to the shopping cart through a clearly visible call-to-action button. Below, additional related products are suggested to enhance the user’s browsing experience. The consistent visual layout ensures usability and aligns with the branding of Pekunden Pottery SMEs.

c. Product detail page

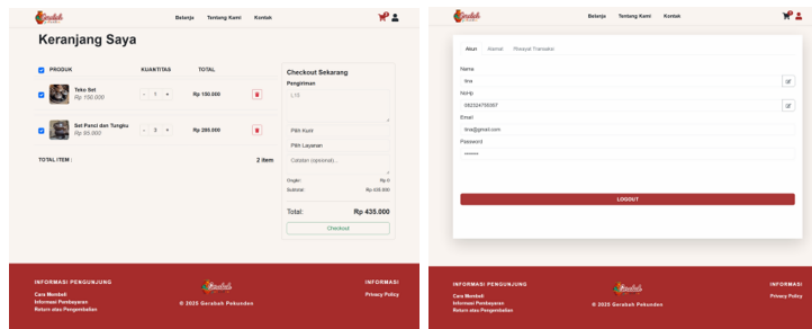


Figure 8. Shopping Cart Page and User Profile Page

The figure displays two key user interface screens from the Pekunden Pottery e-commerce website. The left side shows the shopping cart page, where selected items are listed along with product names, quantities, and total prices. Users can adjust quantities, select courier services, add shipping notes, and view the calculated total including shipping costs before proceeding with checkout.

The right side presents the user profile page, which allows registered users to view and update personal information such as name, phone number, email, and password. The layout promotes clarity and usability, ensuring users can easily manage account data. These components play a crucial role in supporting personalized and efficient transactions within the system.

d. Cart and Checkout Page

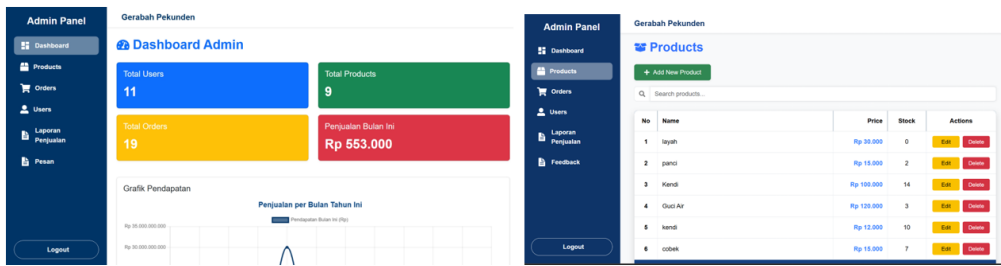


Figure 9. Admin Dashboard and Products Management Page

The figure showcases two core interfaces of the administrative panel in the Pekunden Pottery website system. The left side displays the Admin Dashboard, which provides an overview of key business metrics, including total users, total products, total orders, and current month's revenue. A graphical chart is included to show monthly income trends, aiding administrators in performance analysis.

The right side illustrates the Product Management Page, where administrators can view, edit, delete, or add products. The table lists product names, prices, available stock, and actions. This interface facilitates streamlined inventory control and ensures efficient product data management to support smooth operations.

e. Profile Page

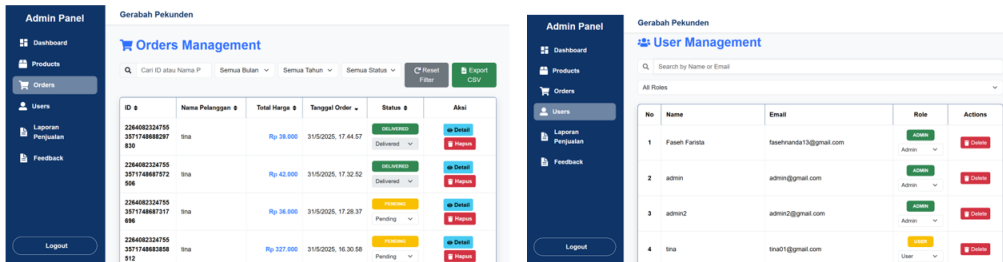


Figure 10. Orders Management Page and User Management Pages

The figure illustrates two administrative functionalities provided in the Pekunden Pottery website system. The left side displays the Order Management Page, where administrators can monitor and process customer orders. Each entry includes customer name, total payment, date of order, status, and action buttons for status update or detail view. The filtering tools and export-to-CSV feature enable efficient tracking and reporting of transactions.

The right side presents the User Management Page, allowing administrators to view, filter, and manage registered users. The table includes user names, email addresses, roles (admin or user), and actions for editing or deleting user accounts. These features support system security and role-based access control while facilitating user maintenance within the platform.

f. Admin Dashboard Page

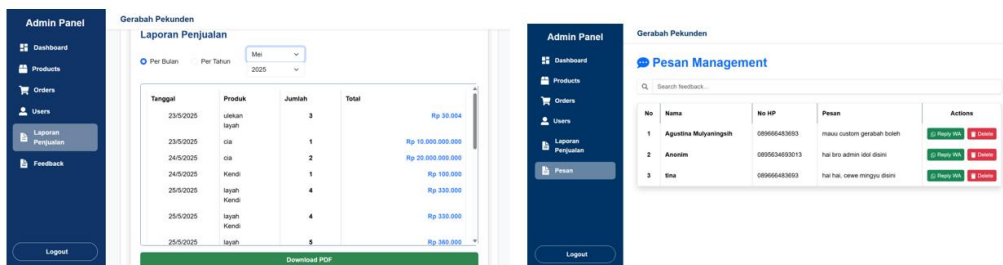


Figure 11. Sales Report Pages and Feedback Management Pages

The figure displays two supporting administrative features in the Pekunden Pottery website system. The left side presents the Sales Report Page, where administrators can monitor sales transactions by month or year. Each row contains transaction date, product name, quantity sold, and total amount. A PDF export

feature is provided for documentation and reporting purposes, enhancing the transparency and traceability of business performance.

The right side shows the Feedback Management Page, which allows administrators to receive and manage user messages or inquiries. The table includes sender name, contact number, message content, and response actions (reply/delete). This feature supports interactive communication and customer service functions, fostering better engagement between administrators and users.

1.4. Testing

The testing phase was conducted to determine whether the system functionalities conformed to the predefined functional requirements. A black-box testing approach was employed, focusing on evaluating input-output behavior without examining the internal source code. This testing targeted core modules including user authentication, product management, order processing, and sales reporting.

Testing involved two main user roles: administrators and customers of the *Pekunden Pottery MSME* website. A total of 11 participants were involved, consisting of 6 administrators and 5 customers. Each administrator executed 45 test scenarios (totaling 270 test cases), while each customer performed 20 test scenarios (100 test cases), resulting in a combined total of 370 test cases.

The outcome of the testing is summarized in Table 4.

Table 4. Table Recapitulation Blackbox Testing

Role	Participants	Test Scenarios	Total Test Cases	Failed	Passed
Administrator	6	45	270	5	265
Customer	5	20	100	5	95
Total	11	65	370	10	360

Of the 370 test cases executed, 360 were successful, resulting in a functional success rate of 97.29%, calculated as follows:

$$\text{Feasibility Percentage} = \frac{\text{Total Successful Test Cases}}{\text{Total Test Cases}} \times 100\% \quad (1)$$

This equation reflects the proportion of successful test executions relative to the total number of tests conducted.

$$\text{Feasibility Percentage} = \frac{360}{370} \times 100\% = 97.29\% \quad (2)$$

In addition to functional accuracy, further evaluation was conducted by measuring system response time and collecting feedback from test users. The average response time for page loading and transaction processing was recorded at 1.8 seconds, which is considered stable and acceptable for MSME web platforms. Furthermore, qualitative feedback from participants indicated that the system was easy to navigate, responsive, and met their business needs. None of the participants suggested further improvements, reflecting a high level of user satisfaction. These results strengthen the evidence that the system is not only functionally reliable but also provides a positive user experience, increasing its readiness for real-world deployment.

While this indicates that the system is functionally reliable and ready for deployment, the 10 failed cases require further consideration. Most failures occurred in the registration and checkout modules. These were primarily caused by incomplete input validation (e.g., missing mandatory fields or reused email addresses) and unstable responses from the *RajaOngkir* API during peak request times.

These issues highlight the need for stronger validation mechanisms on both the client and server sides, including regex-based input constraints, duplicate email checks, and improved error-handling strategies. For API instability, retry mechanisms, timeout thresholds, and caching strategies for shipping costs could mitigate system downtime. This is consistent with prior findings, which emphasize that robust error handling and reliable integration with third-party APIs are critical for maintaining consumer trust and ensuring smooth transaction processes in MSME e-commerce platforms (Arta et al., 2022; Dyatmika et al., 2023).

Furthermore, ensuring reliability in modules such as product search, order processing, and payment aligns with digital marketing literature, which highlights that seamless digital experiences and transaction security are central to building consumer trust and enhancing MSME competitiveness in the digital economy (Akbar

et al., 2022; Baihaqi & Widodo, 2025). These results confirm that the system not only fulfills its functional requirements but also contributes to strengthening MSME competitiveness through digital transformation.

2. Discussion

The functional testing results, which achieved a 97.29% success rate (360 successful test cases out of 370), provide strong evidence that the developed system is capable of meeting user needs. This outcome is consistent with the research objectives established at the beginning, namely to design a web-based information system that facilitates product promotion, online transactions, and structured sales reporting for the Pekunden Pottery MSME. The high success rate demonstrates that the system is not only functionally reliable but also effectively supports the operational needs of both administrators and consumers.

Beyond the quantitative results, qualitative feedback obtained from the test participants further validates this finding. Both administrators and consumers reported that the website was easy to navigate, responsive, and practical in supporting daily business activities, particularly in online ordering and sales reporting. This aligns with previous studies highlighting that seamless digital interactions and transaction security are key to increasing consumer trust in MSMEs (Quintus et al., 2024; Zaheer et al., 2024).

Nevertheless, the occurrence of 10 failed test cases highlighted several critical issues that required further refinement. These failures were primarily caused by incomplete input validation during the registration process and unstable responses from the RajaOngkir API during checkout. To address these problems, the development team first applied direct bug fixes, such as adding stricter input validation rules and improving error-handling mechanisms.

In addition, following the iterative principles of Extreme Programming (XP), these failures were also used as feedback to initiate a new iteration cycle. During this iteration, the team enhanced the registration module by applying regular expressions (regex) for input validation, ensuring that user data such as email addresses and phone numbers conformed to the required format. Furthermore, duplicate email detection was implemented to prevent account conflicts, and retry mechanisms were added for API calls to handle unstable connections with RajaOngkir.

By combining immediate bug fixes with improvements carried out in a structured XP iteration, the corrective measures not only resolved the short-term problems but also increased the long-term stability and reliability of the system, ensuring closer alignment with the principles of XP.

2.1. Implications

The findings of this study carry significant implications in both practical and academic contexts. From a practical perspective, the implementation of a web-based information system enables the Pekunden Pottery MSME to enhance product promotion effectiveness, expand market reach through online platforms, and streamline transaction processing and sales reporting. The integration of Midtrans as a payment gateway and RajaOngkir for automated shipping cost calculation improves customer experience by simplifying purchasing procedures while simultaneously enhancing operational efficiency for administrators. These results reaffirm that digital transformation serves as a strategic tool to strengthen MSME competitiveness in the digital economy, particularly for enterprises that have traditionally relied on conventional marketing practices.

When compared with prior studies, this research provides a distinct contribution. Previous works have emphasized the role of social media marketing and digital virality in enhancing SME visibility (Petropoulou et al., 2024), while others demonstrated that digital marketing strategies significantly improve SME sales performance (Abidi et al., 2023). This study advances the discourse by presenting a more integrated approach that not only facilitates digital promotion but also embeds digital infrastructure into core business processes, including payment and logistics. As such, the proposed system bridges the gap between promotional strategies and operational management within MSMEs.

Additionally, the study highlights the scalability potential of the proposed system. With its modular architecture and the use of Extreme Programming (XP), the framework can be adapted to other MSMEs across diverse industries such as food, fashion, and handicrafts. Although sector-specific adjustments may be necessary, the general structure provides a replicable and adaptable model that can support broader MSME digitalization initiatives.

2.2. Research Contribution

This study contributes to both practical and academic domains.

From a practical standpoint, the system offers a concrete technological solution to the marketing and sales management challenges of the Pekunden Pottery MSME. By integrating third-party services such as Midtrans and RajaOngkir, the system delivers an end-to-end digital ecosystem that strengthens transaction reliability and customer trust. Unlike previous studies that primarily concentrated on digital promotion through social media platforms (Petropoulou et al., 2024) or focused mainly on sales growth via digital marketing strategies (Abidi et al., 2023), this research demonstrates the design of a fully integrated system that holistically supports MSME operations.

From an academic standpoint, the study enriches the literature on agile software development by showcasing the application of Extreme Programming (XP) in the MSME context. The iterative and collaborative nature of XP proved effective in addressing dynamic requirements and resource constraints typical of small enterprises. Furthermore, the integration of third-party services illustrates how modular architectures combined with agile methodologies can enhance adaptability, reliability, and user experience in digital business systems. This provides valuable methodological insights for future research at the intersection of agile development, e-commerce, and MSME digital transformation.

An additional contribution lies in the system's scalability potential. Although this implementation was limited to a single MSME case, the modular structure and XP-driven development approach enable broader applicability. The framework can be replicated and adapted across industries, serving as both a methodological reference and a practical model for future MSME digitalization efforts.

2.3. Limitations

This study has several limitations that should be acknowledged as considerations for future development.

First, the system implementation was limited to a single MSME with unique characteristics and business processes, which restricted the generalizability of the findings. Broader validation across multiple MSMEs from diverse sectors such as food, fashion, and handicrafts is required to assess scalability and adaptability in different business contexts.

Second, the evaluation process was restricted to functional verification using black-box testing within a limited timeframe. The absence of usability testing with larger user groups, as well as the exclusion of performance, load, and security testing, limits the assessment of the system's robustness under real-world operational conditions.

Third, the features developed in this study were confined to core functionalities such as product management, transaction processing, and sales reporting. Advanced functionalities including order tracking, cancellation handling, and real-time notifications were not implemented. Moreover, the system has not yet been integrated with widely used MSME digital ecosystems, such as social commerce platforms and online marketplaces, which could restrict broader adoption.

Fourth, the study may also be influenced by potential respondent and observation bias. Although the 30 respondents included diverse categories such as potential pottery customers, existing customers, website users, and housewives the limited sample size may not sufficiently capture the perspectives of broader market segments. Similarly, reliance on interviews with the head of the Pekunden Pottery Association may introduce subjectivity in assessing business needs. These constraints affect the external validity of the findings and should be considered when interpreting the scalability of the proposed system.

Finally, the system was developed only for desktop web platforms without dedicated mobile applications. Considering that the majority of internet users in Indonesia access digital services primarily via mobile devices, the absence of mobile compatibility poses a potential barrier to user adoption and system scalability.

2.4. Suggestions

Based on the results of system development and the limitations identified in this study, several recommendations can be proposed for future enhancements. The first and most urgent recommendation is the implementation of an order tracking feature through courier service API integration. This functionality would allow customers to monitor the status and location of their packages in real time, while also providing estimated delivery times. By improving transparency and convenience, order tracking has the potential to significantly strengthen customer trust and should therefore be prioritized.

The second recommendation is the development of an order cancellation and modification feature, which can be positioned as a medium-term priority. While less urgent than order tracking, this functionality would provide customers with flexibility to adjust or cancel their orders in cases of input errors, such as incorrect

addresses or product selections. The addition of this feature would not only improve customer satisfaction but also reduce the administrative workload for system operators.

Finally, in the long term, the development of a mobile application should be considered to ensure scalability and wider adoption among MSMEs. Since the majority of Indonesian internet users access digital services via mobile devices, a staged development roadmap is recommended: starting with optimizing the current website for mobile responsiveness, progressing to the creation of a hybrid application with essential features, and eventually advancing to a fully native mobile app with advanced capabilities such as push notifications, real-time tracking, and digital wallet integration.

Through this prioritization and structured development roadmap, the system can evolve progressively to meet user needs more effectively, while ensuring scalability, sustainability, and broader applicability for other MSMEs.

D. Conclusion

This study successfully designed and developed a web-based information system for the Pekunden Pottery MSME as a digital solution to support product promotion, online transactions, and structured sales management. The system was developed using the Extreme Programming (XP) methodology, which enabled an iterative and user-responsive development process.

Key features including user registration, login, product management, purchase transactions, and sales data management were successfully implemented and evaluated through black-box testing, resulting in a 97.29% success rate out of 370 test scenarios. The system's integration with Midtrans (payment gateway) and RajaOngkir (shipping cost API) further facilitated seamless transactions and transparent shipping fee calculations. In addition, the sales reporting feature provides administrators with practical tools to monitor and analyze sales performance, supporting more informed business decision-making.

Beyond its practical outcomes, this study contributes academically by demonstrating the effective application of the XP methodology in the context of MSME system development. It also provides empirical evidence of the benefits of integrating third-party services such as payment gateways and shipping APIs into small-scale digital platforms, thereby enriching the discourse on agile methods and digital transformation in micro and small enterprises.

In conclusion, the system not only meets the research objectives but also advances the academic understanding of agile-based MSME digitalization. Looking forward, this research highlights the potential for broader scalability to other MSMEs and sets the foundation for future development into mobile applications and advanced e-commerce functionalities, ensuring sustainable competitiveness in the digital economy era.

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F. Author Contribution Statement

This research was fully conducted and authored by AM, including problem formulation, literature review, system design, implementation, testing, and the writing of the scientific article. MAG served as the academic advisor, providing conceptual guidance, critical feedback, and academic evaluation throughout the research process.

AM affirms that all content presented in this article is original work, developed under the scientific supervision of MAG. The authors declare that there are no conflicts of interest related to the execution or publication of this study.

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