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Web-Based E-Commerce System Design Using RAD Method: A Case Study of PT Muda Jaya Export

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ABSTRACT

This study focused on the design and development of a web-based e-commerce information system for PT. Muda Jaya Export by employing the Rapid Application Development (RAD) approach. The company had been experiencing inefficiencies in handling transactions, inventory, and order management due to the reliance on manual tools such as Microsoft Excel and communication via WhatsApp. These outdated methods often led to data inconsistencies and delays in processing operations. To address these challenges, the new system was built to streamline and centralize various business functions, including sales transactions, pre-order handling, safety stock monitoring, and reorder point calculation. The platform featured capabilities such as online product ordering, real-time pre-order tracking, automated safety stock and reorder point computations, and secure payment integration through Midtrans. The system was implemented using modern web technologies, including React.js for the frontend, Express.js for the backend, and PostgreSQL for the database. To ensure functionality and user satisfaction, the system underwent testing through the Blackbox Testing technique as well as User Acceptance Testing (UAT). The testing outcomes demonstrated that the newly developed system significantly enhanced the accuracy and efficiency of the company's sales and inventory operations. With this integrated solution, PT. Muda Jaya Export was better equipped to manage its business processes, reducing operational errors and delays. Furthermore, the system contributed to improved data reliability and provided valuable support for making informed decisions related to inventory levels and customer orders.

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1. Introduction

In the rapidly evolving digital era, the utilization of information technology has become a pivotal factor in supporting operational activities [1]. This reality demands human resources capable of maximizing technological advancements. Companies leveraging information technology can streamline various operational processes to achieve their objectives [2]. Integrated and computerized systems enable businesses

to obtain faster and more accurate information [2]. Aligned with this progress, various business sectors have adopted information technology in multiple forms to enhance market competitiveness [3].

One of the most effective strategies for integrating information technology into business operations is through the adoption of electronic commerce, or e-commerce [4], [5]. In Indonesia, the e-commerce industry has witnessed rapid and substantial development, becoming a critical component of the country's digital economic landscape [6]. By 2022, the total value of Indonesia's e-commerce market reached approximately USD 59 billion and is projected to grow to USD 95 billion by 2025 [6]. E-commerce enables producers and consumers to engage in online transactions using digital technologies such as computers, the internet, and online payment systems [7]. This digital infrastructure allows businesses to not only accelerate their sales processes but also better understand, predict, and meet customer demands in a dynamic market environment [8], [9].

Despite its potential, not all businesses in Indonesia have fully embraced or optimized the benefits of e-commerce in their operations [2], [10]. Many small to medium enterprises (SMEs) still depend on traditional, manual systems for transaction processing and inventory control, which hampers their ability to compete in an increasingly digital market.

A relevant example is highlighted in research conducted by Pristiansyah, which discusses the export potential of briquettes—a key Indonesian commodity [11]. Briquettes are environmentally friendly solid fuels made from biomass waste, particularly coconut shells, known for their high carbon content and long-burning properties [11], [12]. These briquettes not only offer a sustainable energy alternative but also help reduce waste and reliance on costly firewood, which can cost up to IDR 20,000 for a small bundle [12]. Their dual benefit of waste management and renewable energy positions them as a promising product in both domestic and international markets.

PT Muda Jaya Export, a company involved in the production and sale of briquettes, currently encounters operational inefficiencies due to its reliance on conventional tools such as Microsoft Excel for recording sales and inventory, and WhatsApp for managing transactions [10]. This fragmented approach results in frequent difficulties in tracking order statuses and monitoring inventory levels, often causing either excess stock or shortages [13], [14]. Moreover, the manual input of data increases the risk of human error, which can lead to discrepancies between the data recorded and the actual stock availability [2], [15].

Similar challenges were observed in a study by Helling and Nada at PT Jomini Coco Internasional, where the absence of a centralized system hindered operational effectiveness [10]. The implementation of a web-based information system using a prototyping development model allowed the company to streamline its sales process, enhance product information access, and improve reporting capabilities [10], [16]. Drawing from these findings, the adoption of integrated, web-based e-commerce systems can offer significant improvements in transaction accuracy, operational efficiency, and business scalability, especially for companies involved in export and high-demand product markets such as briquettes.

To address the operational inefficiencies and challenges faced by PT Muda Jaya Export, the development of a web-based e-commerce information system has become essential. This proposed system is designed to integrate several core business functions—namely sales management, pre-order tracking, safety stock monitoring, and automated reorder point calculation—into one cohesive digital platform [13], [9]. Such integration is critical for modernizing the company's operations, which currently rely on disjointed tools and manual processes that are prone to errors and delays. One of the primary goals of the new system is to streamline order management, allowing customers to place and track transactions online efficiently [7]. This feature is expected to not only improve the customer experience but also reduce administrative burdens on staff. Additionally, a pre-order module will support better production planning by enabling the company to anticipate demand before manufacturing begins [17]. This predictive capability is particularly useful for export-oriented businesses like PT Muda Jaya Export, which must manage large, variable orders.

The inclusion of a safety stock feature is equally important, as it helps ensure product availability even during periods of unexpected demand surges or supply chain disruptions [18], [19]. By maintaining a buffer inventory, the company can avoid stockouts and lost sales. Complementing this is the reorder point functionality, which automatically signals when stock levels reach a predefined threshold, prompting timely restocking and minimizing the risk of over- or under-inventory situations [13], [14].

To develop the system efficiently and in alignment with the company's operational needs, the Rapid Application Development (RAD) methodology will be utilized [20], [21], [16]. RAD emphasizes fast, iterative development cycles that allow for ongoing user involvement and feedback. This collaborative approach involves prototyping and flexible modifications, which are vital for refining the system's features in real time [21], [23]. Through close interaction between developers and end-users, RAD not only accelerates the development timeline but also ensures that the final product is both functional and user-friendly [20], [16], [22].

2. Research Method

The research methodology comprises systematic steps designed to achieve the study objectives [23]. This research employs a methodology that includes data collection processes, requirements planning, RAD workshop design, and system implementation [20][21]. The research method and workflow stages are illustrated in Figure 1.

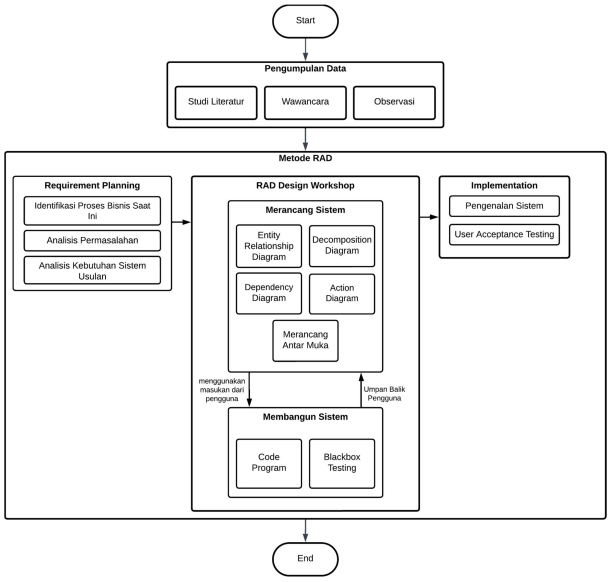

Figure 1. Research Methodology Flow

2.1. Data Collection

The data collection phase is the stage where data is gathered to obtain the necessary information to achieve the research objectives [23]. Data collection is conducted through Literature Review, Interviews, and Observations [15][24].

2.1.1 Literature Review

Data collection is carried out by conducting a literature review through searching for references in the form of research journals, books, articles, and other reliable sources available online that are related to the topic of designing a website-based sales information system for briquettes, as well as the methodology of software development using RAD [20][21][16]. The information obtained from the literature review is used to compile a literature review as a theoretical foundation, design relevant research methodology, and develop the information system according to the desired specifications [2], [1].

2.1.2 Interviews

An interview is a method of data collection through direct interaction with respondents who have relevant information to obtain the required data [23]. In this phase, a conversation was conducted between the researcher and one of the company owners, Achmad Erlangga Bintang Samodra, by asking various questions to gather data and information needed for system development [10], [15].

2.1.3 Observation

The observation phase is a stage aimed at obtaining any information from an event through direct observation [23]. In this phase, direct observation was conducted by visiting the location of PT Muda Jaya Export [10][15].

2.2. Development Methodology (RAD)

The development methodology used in this thesis is Rapid Application Development (RAD). Below are the stages of the RAD methodology applied in this research:

2.2.1 Requirements Planning

In this stage, the process of identifying the objectives of the application or system and determining the information requirements needed to achieve those objectives is carried out [22][23]. The following are the steps in planning the requirements for the website-based sales information system for briquettes:

2.2.1.1 Identification of Current Business Processes

This is the initial stage in system analysis where the developer collects information about the current business processes running within the organization or company [23]. The objective is to understand how work is currently being done, including workflows, roles, and responsibilities [10][15].

2.2.1.2 Problem Analysis

Problem analysis involves identifying the challenges faced by PT Muda Jaya Export [10]. This analysis involves collecting and evaluating data through interviews and literature reviews to identify specific problems that need to be addressed by the system being developed [2][13]. With a clear understanding of these problems, appropriate steps for their resolution can be formulated [23].

2.2.1.3 Analysis of Proposed System Requirements

In this stage, the author identifies various system requirements based on the results of interviews, literature reviews, and observations conducted [20][9].

2.2.2 RAD Workshop Design

This stage is carried out collaboratively and iteratively with users to identify all the requirements that should be included in the system [21][16]. Users will provide feedback on the system flow that will be created [22]. The steps involved include:

2.2.2.1 Creating an Entity Relationship Diagram (ERD)

In this step, the process of creating a diagram that illustrates the relationships between entities in the system is carried out [23]. ERD is used to model the data structure by defining entities, attributes, and relationships between entities [25][26].

2.2.2.2 Creating a Decomposition Diagram

In this step, the developer creates a decomposition diagram to break down functions, processes, or procedures into smaller parts to understand the system structure in detail [23].

2.2.2.3 Creating a Dependency Diagram

In this step, the developer creates an action diagram that explains the procedural logic, including conditions, loops, and actions that govern the processes in the system [23].

2.2.2.4 Creating an Action Diagram

In this step, the developer creates an action diagram that explains the procedural logic, including conditions, loops, and actions that govern the processes in the system.

2.2.2.5 Designing the User Interface (UI)

In this step, the user interface design is created according to user needs [27], [28]. Below is the proposed user interface design.

2.2.2.6 Coding Program

In this stage, the developer translates the designed system into executable code [4], [29]. This process involves using data structures, algorithms, and programming logic to ensure that the system functions according to the predefined system design [30], [31].

2.2.2.7 Blackbox Testing

After the coding phase is completed, the developer performs system testing using blackbox testing [32]. The developer only looks at inputs and outputs to determine whether the software functions as expected according to the specified requirements [32].

2.2.2.8 User Feedback

In this stage, the developer interacts with potential users to discuss the designed system [21][16]. Feedback from potential users is crucial to ensure that the system to be built meets their expectations and requirements [33]. This feedback also allows developers to make changes such as simplifying processes or adding features to improve the user experience [16]. If there is an evaluation of the designed system, improvements are made in the next iteration [20][21].

2.2.3 Implementation

In this stage, the designed and built system is introduced or demonstrated to potential users, and the system undergoes testing using User Acceptance Testing (UAT) along with system maintenance [33][34].

2.2.3.1 System Introduction

In this step, the process of introducing or demonstrating the completed system to potential users is carried out [33].

2.2.3.2 User Acceptance Testing (UAT)

In this step, User Acceptance Testing (UAT) is conducted, where users test the system to ensure that the developed system meets their needs [34]. The UAT process produces documentation that serves as proof

of system acceptance, validating that the software effectively meets user requirements [33][34]. The steps in UAT include identifying test scenarios based on real-use cases, conducting tests by users according to the defined scenarios, recording test results, and evaluating whether the system has met the acceptance criteria set beforehand [34].

3. Result and Discussion

The data collection phase is the stage where data is gathered to obtain the necessary information to achieve the research objectives. Data collection is conducted through Literature Review, Interviews, and Observatuio.

3.1. Requirements Planning

Requirements planning is the stage where the needs and objectives of the system are identified. At this stage, potential users are invited to provide input so that the developed system will meet their requirements. In this phase, there are several stages such as identification of current business processes, problem analysis, and proposed system requirements analysis

3.1.1 Identification of Current Business Processes

Identifying the current business process is a stage where the developer identifies the business processes currently running in the organization or company before the new system is built.

The product purchasing process at PT. Muda Jaya Export is carried out conventionally through WhatsApp, handled by an admin. Figure 2 illustrates the flow of the product purchasing process which involves interaction between the customer, admin, and factory. When the product is available, the customer can directly visit the factory to purchase a product sample. If the purchased product meets the customer's expectations, the customer proceeds to buy the desired quantity and pays a down payment (DP) as initial proof of the transaction. The admin then forwards the order to the factory for production. The factory checks the availability of raw materials and starts the production process if sufficient materials are available. Once the product is finished, it is shipped to the customer. The process continues with the customer making the remaining payment, which is then verified by the admin before the invoice is issued as proof of the transaction.

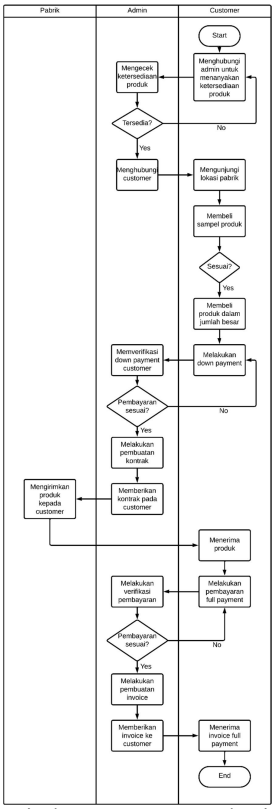

Figure 2. Swimlane Current Purchasing Process

Figure 3 depicts the sales process at PT. Muda Jaya Export, involving both the factory and the admin. It illustrates the workflow of activities that occur from production to the marketing of products by the admin across various social media platforms. The process begins with the production of goods, which are then stored in the warehouse. Following this, the products are promoted through various social media channels to attract consumer interest.

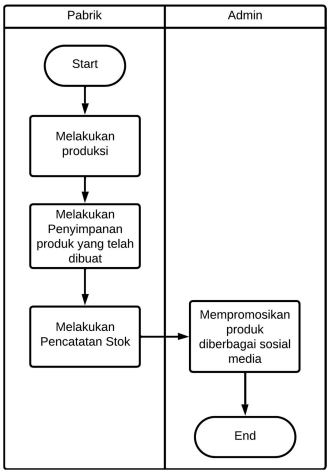

Figure 3. Current Sales Process Swimlane

3.1.2 Problem Analysis

Problem analysis is an effort to identify the constraints currently experienced by PT Muda Jaya Export. This analysis involves the process of collecting and evaluating data through interviews and literature review to uncover specific problems that need to be addressed by the system to be developed. With a clear understanding of these issues, appropriate steps for their resolution can be formulated.

PT Muda Jaya Export, as a company engaged in production and sales, faces challenges in optimizing its sales process and product availability. This is due to the continued use of a conventional system in its current business processes. The identified problems include:

Table 1. Problems and Solutions

No	Permasalahan	Solusi
1	Product orders are still managed through WhatsApp. This often leads to difficulties in managing and monitoring incoming orders.	Product orders are placed through a website.
2	Inventory management is still conducted using Microsoft Excel and WhatsApp, making it difficult to monitor effectively.	There is a feature in the system that allows for stock recording and the calculation of the minimum stock level required in the warehouse, using the reorder point as the threshold for reordering or reproducing products.
3	The use of Microsoft Excel for recording sales data causes inconsistencies and discrepancies in the data.	There is a system feature that enables monitoring of incoming sales without the need for manual data entry, thereby reducing the occurrence of data discrepancies.

3.1.3 Analysis of Proposed System Requirements

In the proposed system requirements analysis phase, the author identifies various system requirements based on the results of interviews, literature review, and observations conducted. Based on the interview results carried out by the researcher with the director of PT. Muda Jaya Export, the user requirements for the e-commerce information system of PT. Muda Jaya Export is identified as follows:

Table 2. System Requirements

No	Name	Description
1	Admin	The admin has full access and control over all features and functionalities within the system. Their responsibilities include managing category data, variant data, customer data, order data, product data, safety stock and reorder point settings, as well as generating and managing sales reports.
2	Customer	Customers in the system can create an account, access product-related information, purchase products, make payments, view order history, and manage their account.

Figure 4. illustrates the product purchasing process involving two key actors: the Admin and the Customer . The process begins with the Admin adding a product to the system by filling out and submitting a product data form, after which the system validates the data and displays the product information on the product page. The Customer can then view available products, including pre-order options, and select items to add to the cart. If the product quantity is sufficient, the Customer proceeds to checkout and makes a payment using methods such as credit card, bank transfer, or digital wallet. The system then verifies the order format, checks data storage, and confirms the payment status. Upon successful validation, the system redirects the Customer to the order confirmation page, records the transaction, and finally directs them to the order history page, completing the process once all steps are successfully executed. If any issues arise—such as invalid data, unavailable stock, or failed payments—the system displays an error message to guide the Customer in resolving the issue before continuing.

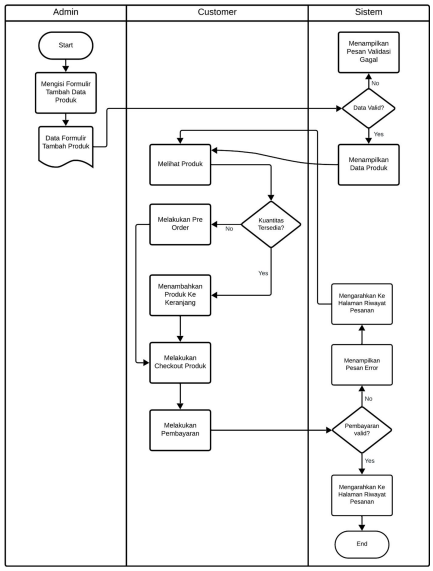

Figure 4. Swimlane Proposed Purchasing Process System

Figure 5 illustrates the process of calculating safety stock and reorder point, which involves the Admin as the main actor. The process begins when the Admin fills out a form to input the necessary data for the calculation of safety stock and reorder point. The system then receives and validates the submitted data; if

valid, it proceeds to calculate the values using predefined formulas and displays the results to the Admin. If the data is invalid, the system shows an error message to alert the Admin to correct the input. The process ends once the calculation results are successfully displayed.

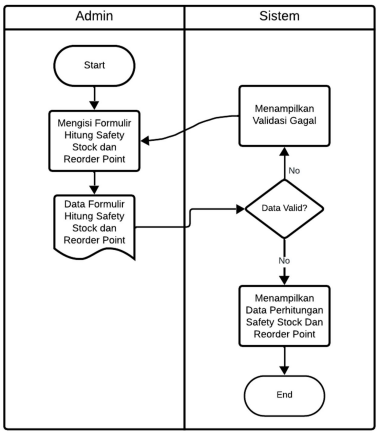

Figure 5. Swimlane System Proposed Calculation Process of Safety Stock and Reorder Point

3.2. RAD Workshop Design

This stage involves collaboration between the developer and the user to carry out a series of modeling and system development processes that align with the previously identified user business needs. It includes the creation of an Entity Relationship Diagram (ERD), Decomposition Diagram, Dependency Diagram, Action Diagram, and User Interface design.

3.2.1 Entity Relationship Diagrams Design

The creation of an Entity Relationship Diagram (ERD) aims to visually model the database structure, including tables (entities), attributes (columns), and the relationships between tables, as shown in Figure 6.

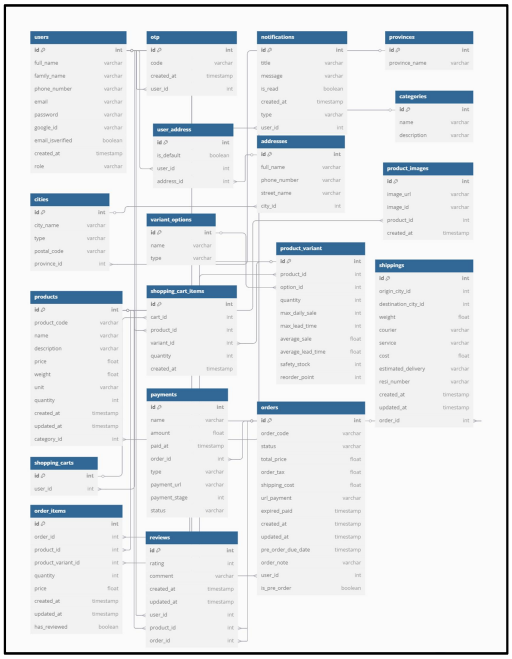

Figure 6. Entity Relationship Diagram

3.2.2 Decomposition Diagram Design

Figure 6 is a decomposition diagram that illustrates the structure of modules or features within the system. The system consists of various management modules that handle different operational aspects, such as product management, order management, user management, notifications, and other related functionalities.

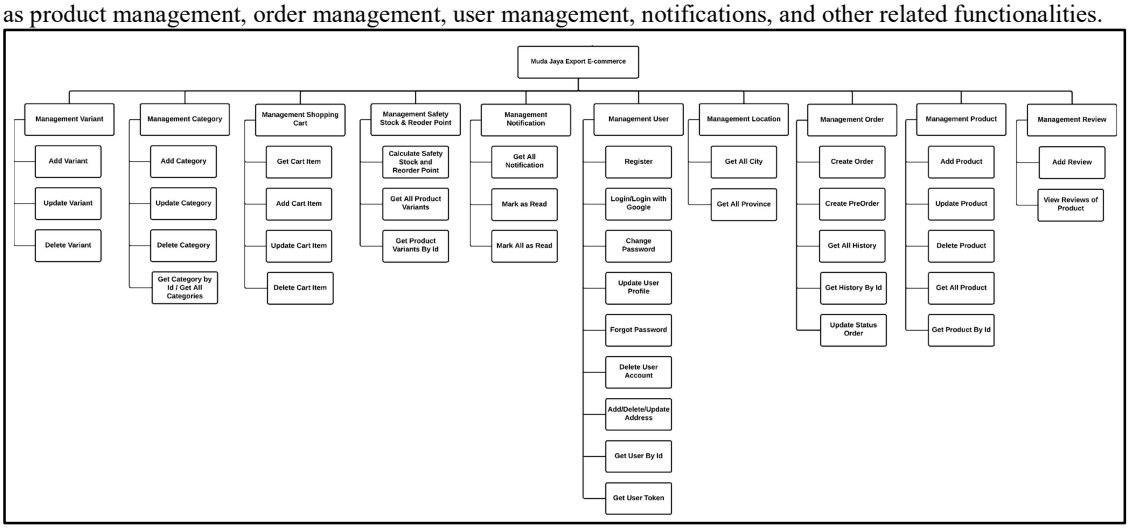

Figure 7. Decomposition Diagram

3.2.3 Dependency Diagram Design

Figure 8 is a Dependency Diagram that illustrates the sequential and logical flow of processes within the system, ensuring a structured and systematic business workflow. The process begins with the user registering for an account and logging into the system, after which they can choose between two purchasing options: Buy Now, for products with sufficient stock, or Pre-Order, for items where the available quantity does not meet their request. Both options lead to the Order Creation stage, where the system records the purchase details. The user then proceeds to Checkout, where they select a shipping method and a payment type, such as Full Payment or Down Payment (DP). Once these selections are confirmed, the user moves to the Payment stage. If the payment is successfully verified by the system, the transaction concludes at the Transaction Success page, indicating that the order has been completed successfully.

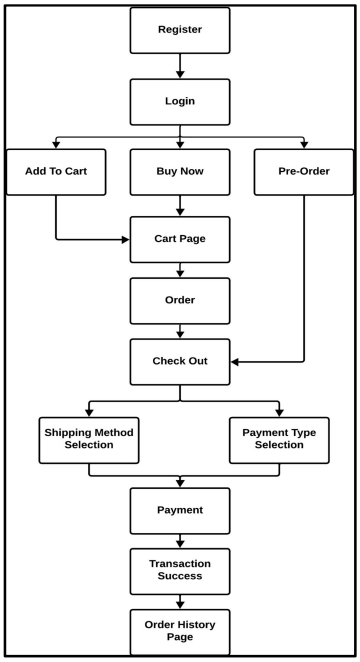

Figure 8. Dependency Diagram

3.2.4 User Interface Design

User interface design in the first iteration aims to create an initial system layout that is responsive, intuitive, and easy to use for end users. The UI design was developed rapidly based on the core functional

requirements of the system. This process involved creating realistic interfaces for essential features such as user authentication, product details, ordering and payment, password recovery, order history, user profile, address management, notifications, as well as management of products, users, orders, and stock.

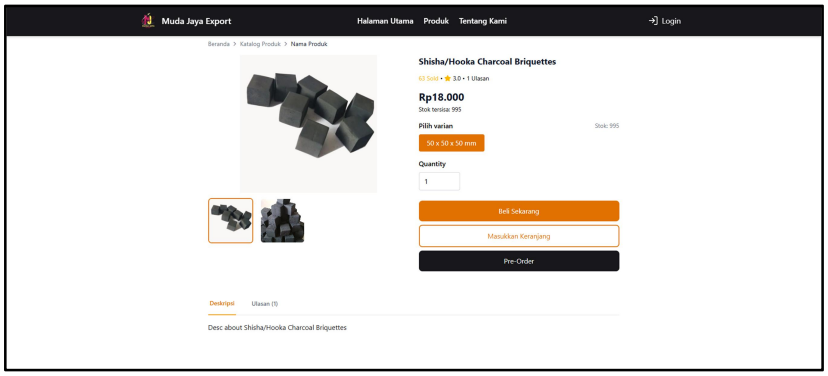

Figure 9. Product Detail Page

Figure 9 shows the Product Detail Page interface, which displays comprehensive information about a specific product. The page includes key details such as the product image, name, price, available stock, number of units sold, average rating, and customer reviews. Users can select product variants and specify the desired quantity before choosing to either add the item to their cart, proceed with an immediate purchase via "Beli Sekarang," or place a pre-order if the product is not currently available. A dedicated description section also provides additional information about the product, ensuring users have all the necessary details to make an informed purchasing decision.

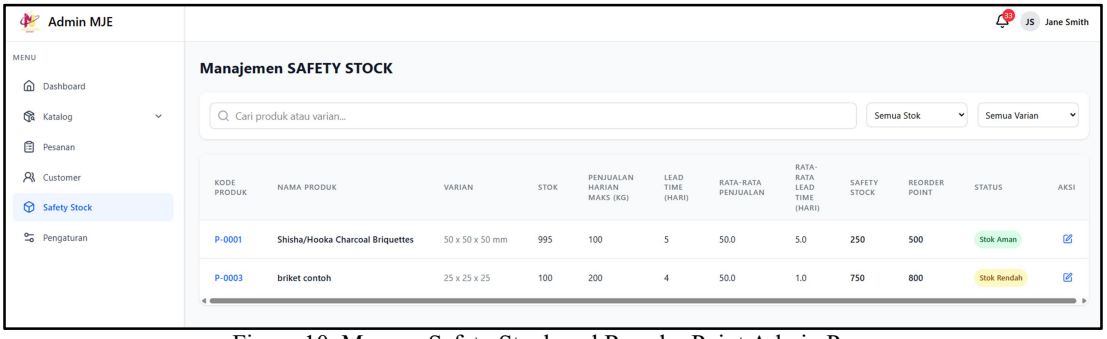

Figure 10. Manage Safety Stock and Reorder Point Admin Page

4. Conclusion

Based on the results of research and development of a website-based e-commerce information system for PT. Muda Jaya Ekspor using the Rapid Application Development (RAD) method, the designed system has been able to meet the company's needs in integrating business processes such as sales, pre-orders, stock management with safety stock and reorder point calculations, and online payment transactions. The system development process is carried out collaboratively and iteratively with prospective users so that the features produced are in accordance with user needs. The results of functional testing through Blackbox Testing and user acceptance (User Acceptance Testing) show that the system is running well. This system also makes it easy for admins to manage products, categories, variants, users, orders, and stock of goods to help the overall business process.

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