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# DESIGN OF E-COMMERCE SUPPLY CHAIN FOR SOYBEAN SALES AT THE INDONESIAN TOFU AND TEMPE PRODUCERS COOPERATIVE (KOPTI) SUMEDANG, WEST JAVA

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## ABSTRACT

The development of the digital era in the Industrial Revolution 4.0 encourages business actors to utilize information technology as a means of increasing efficiency and competitiveness. One form of application of this technology is e-commerce, which plays an important role in accelerating business processes and expanding market reach. For producer cooperatives, especially those engaged in the food sector such as the Indonesian Tempeh Tahu Producers Cooperative (KOPTI) Sumedang, the use of e-commerce is a strategic opportunity to overcome the limitations of manual systems that are still used in sales and distribution activities. This research aims to design and develop a web-based e-commerce prototype to support the supply chain of KOPTI Sumedang so that the flow of information and goods becomes more efficient and transparent. The research approach is carried out through the stages of identifying user needs, designing system features, building prototypes, and testing the basic functions of the system. The results of the study show that the implementation of an e-commerce system is able to speed up the ordering and payment process, reduce stock data errors, and expand market reach beyond the Sumedang area. The implementation of this system also improves coordination between supply chain actors, ranging from suppliers and manufacturers to retailers and consumers. This research contributes to the development of the digitalization of community-based cooperative supply chains, which is expected to be a reference for strengthening the digital transformation of the small and medium business sector in Indonesia.

**Keywords:** e-commerce, supply chain, prototyping.

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## 1. INTRODUCTION

Digital transformation in the era of the Industrial Revolution 4.0 has driven major changes in the way organizations conduct business activities (Herman & Pantek, 2015). Information technology no longer functions simply as an operational tool but has become a strategic factor in increasing the efficiency and competitiveness of companies. This technology allows work processes to be carried out faster, more precisely, and more integrated, thus helping companies make data-driven decisions in real time. The application of information technology is able to encourage business process efficiency while strengthening the company's competitive advantage through improving information quality, accelerating workflows, and better process integration (Prihandono & Amir, 2024). The use of digital technology can expand market reach around the world and allow business activities to take place without space and time limitations (Rafiudin, 2006) .

One of the most widely used applications of information technology in business today is e-commerce. Electronic commerce (EC) refers to using the Internet and other networks (e.g., intranets) to purchase, sell, transport, or trade data, goods, or services (Turban et al., 2017). Its use provides great efficiency for business actors, both in terms of cost and time, because promotions can be carried out through the internet at a lower cost and various business processes can be accelerated through automation and digital communication, such as email (Alwendi, 2020). This efficiency also improves the quality of customer service and strengthens competitiveness as transactions and communication become easier. In addition, the success of e-commerce depends on various core components, including customers, sellers, products (some digital), infrastructure, front-end processes, back-end activities, electronic intermediaries, other business partners, and support services that guarantee the security and smooth running of transactions, which together form an integrated digital ecosystem (Turban et al., 2017).

EC includes business-to-business (B2B) and business-to-consumer (B2C) and can take various forms such as EDI, direct relationships with suppliers, the Internet, intranets, extranets, electronic catalog orders, and email (Li, 2001). Turban et al. (2017) further classify e-commerce into various interaction models, including Business-to-Business (B2B), Business-to-Consumer (B2C), Business-to-Business-to-Consumer (B2B2C), Consumer-to-Business (C2B), Consumer-to-Consumer (C2C), Mobile Commerce (M-Commerce), Intrabusiness E-Commerce, Business-to-Employees (B2E), Collaborative Commerce, Non-business E-Commerce, and E-Government. This classification describes the wide scope of e-commerce applications and demonstrates their adaptability across the needs of organizations and user groups.

Supply Chain Management (SCM) is the process of planning, managing, executing, and improving key business processes to ensure the effective delivery of products and services from suppliers to end customers. It involves the flow of information, materials, and services, integrating customer specifications to improve the internal processes and performance of upstream suppliers (Helmond et al., 2022). This concept is an important foundation because e-commerce serves as a tool that encourages integration in the supply chain, accelerates the dissemination of information, and improves the efficiency of the procurement-to-distribution process.

In the context of supply chain management, e-commerce has a critical role. The supply chain is a network of activities that controls the flow of goods, information, and money among suppliers, producers, distributors, retailers, and consumers (Pujawan, 2010). The supply chain involves several key actors, namely suppliers as the first link in the chain that provides raw materials; manufacturers who convert raw materials into finished products; distributors who manage product delivery with cost and responsiveness considerations; retailers who sell products directly to consumers; and the end consumer itself (Indrajit & Djokopranoto, 2003). In this structure, three main streams must be effectively managed: upstream to downstream product flows, financial flows from downstream to upstream, and information flows that include data on stock availability, production capacity, and delivery status.

Academic studies underscore the significance of sharing and integrating information throughout the supply chain to enhance coordination and minimize delays. Integrated information flows support faster decision-making and reduce mismatches between market supply and demand (Zhao et al., 2011).

The absence of digital integration often results in inaccurate forecasts, communication gaps, and inefficiencies in operational activities. Electronic supply chain management (e-SCM) improves responsiveness, transparency, and synchronization among supply chain actors (Gunasekaran & Ngai, 2004).

The Indonesian Tempeh Tofu Producers Cooperative (KOPTI) Sumedang is one of the cooperatives engaged in the distribution of soybean raw materials for tempeh and tofu producers, as well as retailers in the Sumedang area. Based on field observations, the transaction system at KOPTI is still carried out traditionally, starting from orders and payments to promotions that only rely on verbal communication. This condition causes several obstacles, including delivery delays, inaccurate order numbers, and limited raw material stock information. Furthermore, the lack of a digital system supporting integrated marketing and distribution limits KOPTI's market reach.

Several previous studies have indicated that the implementation of e-commerce can improve supply chain efficiency. Mu, Zheng, and Sun (2021) examined green technology innovations in e-commerce sales channels in a two-stage supply chain. Meanwhile, Kashurnikov et al. (2019) discussed the prospects for the implementation of e-commerce in supply chain management in the light industry, and Valentine, Sitinjak, and Pratama (2022) designed a web-based e-commerce system for manufacturing companies. However, research on the implementation of e-commerce in community-based cooperatives such as KOPTI is still very limited, especially those that focus on integration between suppliers, producers, and retailers in a single digital platform.

Based on these problems, this study aims to design and develop a web-based e-commerce prototype that can integrate all actors in the KOPTI Sumedang supply chain. This system is expected to accelerate the flow of information, improve the accuracy of stock data, expand marketing reach, and support the digitization process of community-based producer cooperatives. The development of this system is expected to help KOPTI Sumedang improve operational efficiency and strengthen its competitive position in the ever-growing digital economy.

## 2. METHODS

The research methodology used in this study is presented systematically in the form of a flowchart as shown in the Research Methodology Drawing. The diagram aims to provide a comprehensive overview of the overall research flow and stages, as well as clarify the relationship between processes carried out from the initial stage to the final stage of research.

In general, the methodology of this research consists of three main phases, namely the initial stage of research, the design and development stage of the system prototype, and the final stage of research. Each phase includes a series of steps that are arranged sequentially and interrelated, with the application of an iterative approach at the prototype development stage to ensure a fit between the user's needs and the proposed solution. A detailed explanation of each stage and research activity is further elaborated in the next subsection according to the flow shown in Figure 1.

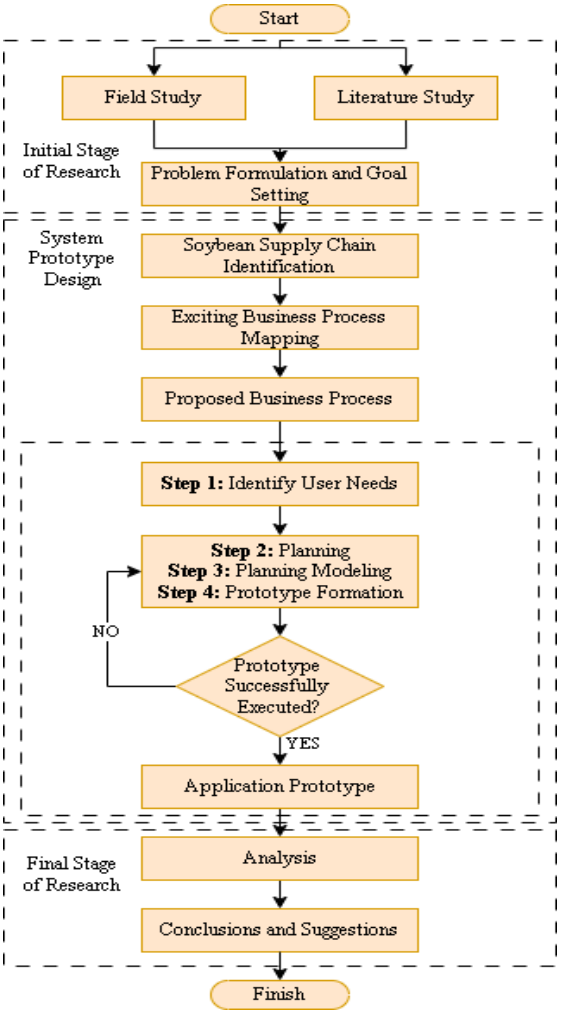


*Figure 1. Flowchart Methods*

The methodology flow describes the stages of research starting from the initial stage of research, design and development of system prototypes, to the final stage of research. Each stage is designed to be integrated with each other to produce a prototype system that suits the needs of users and supply chain conditions at KOPTI Sumedang.

1. Early Stage of Research

The initial stage of research began with field studies and literature studies. The field study was conducted to obtain empirical data on the existing conditions of the soybean supply chain at KOPTI Sumedang, including the actors involved and the operational problems faced. Meanwhile, a literature study is conducted to examine relevant theories, methods, and previous research as a conceptual basis for research. The results of these two activities are used in problem formulation and the determination of research objectives.

2. Soybean Supply Chain Identification

The next stage is the identification of the soybean supply chain in KOPTI Sumedang. At this stage, the identification of key actors in the supply chain is carried out, as well as the mapping of supply chain flows that include material, information, and financial flows. This identification aims to gain a comprehensive understanding of the structure and mechanisms of the supply chain that are the object of the research.

3. Business Process Mapping and Design

Based on the results of the supply chain identification, an existing business process mapping is carried out to describe the ongoing operational process. Furthermore, this study prepares business process proposals as a form of improvement to existing processes. This proposed business process is designed to support the implementation of a more integrated and efficient e-commerce system.

4. Identify User Needs

The prototype development stage begins with the identification of user needs (step 1). User needs are obtained through the results of observations and interviews with related parties at KOPTI Sumedang. This identification includes the functional needs of the system as well as the aspects of ease of use that will be the basis for the design of the system.

5. Planning, Modeling, and Prototyping

The next stage includes system planning (step 2) and planning modeling (step 3) which are compiled based on user needs and proposed business processes. Furthermore, a prototype (step 4) was formed in the form of a website-based e-commerce system. This process is carried out iteratively until the prototype can be executed properly according to the planned function.

6. Prototype Implementation

The successfully executed prototype is then proceeded to the application implementation stage. At this stage, a prototype is used to simulate the operational processes of the system to ensure that the main functions of the system can run according to the designed flow.

7. Final Stage of Research

The final stage of the research includes an analysis of the results of the prototype implementation to assess the level of suitability of the system with the research objectives, especially from the aspects of functionality and usability. Based on the results of the analysis, this study then compiled conclusions and suggestions as a conclusion to the research.

## 3. FINDINGS AND DISCUSSION

### 3.1. Findings

This section presents the findings of the research obtained through observations and interviews with the management and members of KOPTI Sumedang. The findings describe the existing supply chain structure, identify its main actors and flows, and present the design of a proposed e-commerce prototype intended to improve efficiency and information transparency within the supply chain.

Supply Chain Identification at KOPTI Sumedang

1. Identification of Key Actors

The supply chain activities at KOPTI Sumedang involve four main actors, including suppliers who provide raw materials. The suppliers consist of producers of tofu production equipment, imported soybean suppliers, and local soybean suppliers. Suppliers distribute raw soybeans, while KOPTI Sumedang acts as a producer distributing soybeans to retailers. The distribution process plays a role in ensuring that products can be delivered to consumers, including those in remote locations.

Retailers include market traders, vegetable vendors, tempeh and tofu artisans, restaurants, tofu factories, mobile vendors, and street sellers using vehicles. KOPTI sells to market traders, who in turn connect with others, such as vegetable vendors, because they sell not only vegetables but also related food products like tofu and tempeh. In addition to market and vegetable traders, KOPTI supplies soybeans to tempeh-tofu artisans for resale to restaurants. KOPTI also distributes soybeans to tofu factories, which then distribute the products to mobile traders and street vendors, until they finally reach the end consumer. The four actors are interconnected to ensure the availability and distribution of soybeans to the end consumers. Figure 2 shows supply chain identification at KOPTI Sumedang.

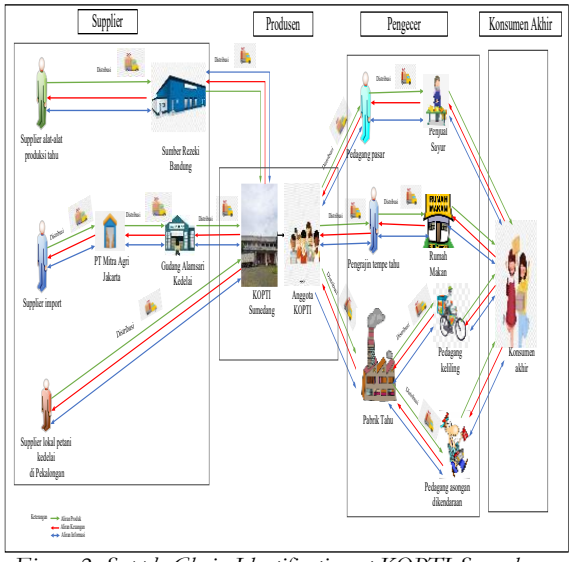


*Figure 2. Supply Chain Identification at KOPTI Sumedang (KOPTI Sumedang, 2021)*

2. Identification of Supply Chain Flows

The supply chain at KOPTI Sumedang includes three main flows: product, financial, and information. The product flow moves from local and imported suppliers to the KOPTI warehouse, then to market traders, tofu factories, and tempeh-tofu artisans, and finally to consumers, with an average volume of 250–500 kg per transaction. The financial flow moves from consumers to retailers and KOPTI members, then to suppliers—for example, purchasing soybeans at around IDR 6,200/kg and reselling at approximately IDR 7,000/kg.

Information related to prices, stock availability, and orders is still submitted manually on both sides, so it has the potential to cause delays. The implementation of a web-based e-commerce system is proposed as a solution to speed up the ordering, payment, and inventory monitoring process, as well as strengthen coordination among supply chain players.

3. E-Commerce Prototype Development

Prototype development is carried out through several stages, namely identifying user needs through observation and interviews, designing system features and interface design, building prototypes using web-based platforms, and then simulating and evaluating them to assess functionality and ease of use (Pressman, 2012).

To achieve this, several stages were conducted sequentially, starting from user requirement identification to prototype simulation and evaluation. Each stage is described in detail as follows:

1. Identifying user requirements through observation and interviews

The system actors include suppliers (both import and local), KOPTI as the producer, retailers (market traders, tempe-tofu artisans, tofu factories, vegetable vendors, and street vendors), as well as the end consumers. User requirements were identified through interviews with KOPTI management to map the business processes and supply chain constraints. The results of these interviews served as the basis for designing the system and compiling a list of user requirements, which became the input for developing the e-commerce platform. Table 1 shows identification of user requirement inputs and outputs.

*Table 1. Identification of User Requirement Inputs and Outputs*

| User | Requirement | Input | Output |
|---|---|---|---|
| KOPTI | Registration | Name, email, password, confirm password | Succesful registration |
| | Log in | Email and password | Succesful login |
| | Product | Product names | Display product names |
| | Product image | Product images | Display product images |
| | Incoming order | Consumer orders | Orders receive |
| | Settings | Company name, store address, phone number | Company Information |
| Supplier | Registration | Name, email, password, confirm password | Succesful registration |
| | Log in | Email and password | Succesful log in |
| | Product | Product names | Product names |
| | Product image | Product images | Product images |
| | Incoming orders | Consumer orders | Order received |
| | Payment | Bank account number | Display transaction proof |
| Retailer | Registration | Name, email, password, confirm password | Succesful registration |
| | Log in | Email and password | Succesful log in |
| | Check out | Product name, quantity, recipient address, phone number | Succesful check out |
| | Payment | Bank account number | Display transaction proof |
| Consumer | Registration | Name, email, password, confirm password | Succesful registration |
| | Log in | Email and password | Succesful log in |
| | Check out | Product name, email, password, confirm password | Succesful check out |
| | Payment | Bank account number | Transaction proof |

2. Planning system features and interface design

The planning stage was conducted to translate user requirements into a web-based e-commerce system model. In this stage, interactions between actors are illustrated using a use-case diagram to map the functions and business process flows of KOPTI Sumedang, ranging from raw material ordering to distribution to consumers. Use-case diagrams serve as a fundamental tool in UML for representing the functional requirements of a system and clarifying how each actor interacts with the system's processes (Sabharwal, Kaur, & Sibal, 2017). In addition, use-case diagrams visually describe actor–system relationships to ensure that all functionalities are captured and aligned with real operational needs (Arifin & Siahaan, 2020). This design ensures that each supply chain actor—suppliers, KOPTI as the producer, retailers, and end consumers—has appropriate access rights and workflow. The resulting design serves as a reference for prototype development. Figure 3 illustrates use case diagram for website access.

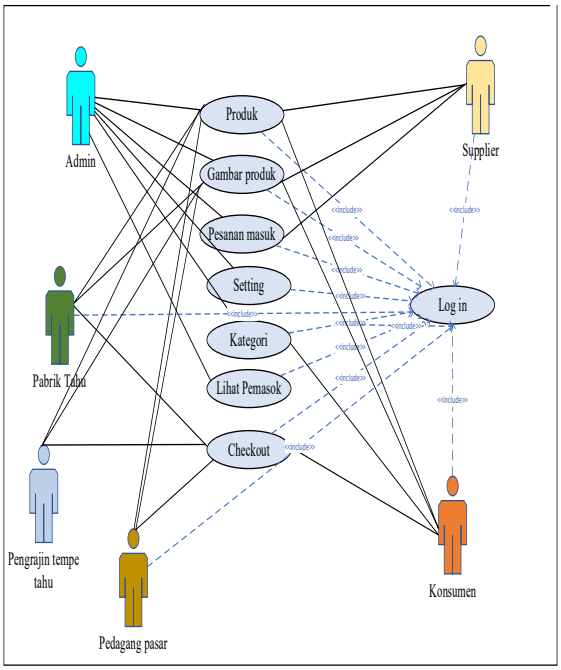


*Figure 3. Use Case Diagram for Website Access*

To explain more about the dynamic process of the system, an activity diagram is developed to represent the detailed workflow for the main operation. An activity diagram, as a behavioral diagram in UML, is used to describe the operational sequence of actions performed by system components in a step-by-step manner (Siewe & Ngounou, 2025). In addition, activity diagrams are effective for modeling complex business processes because they can represent decision flows, parallel operations, and the overall logical structure of system behavior (Elmansouri, Meghzili, & Chaoui, 2021). Two main activities were modeled to illustrate the system logic: the login process and the incoming order process.

The Login Activity Diagram illustrates the authentication procedure when users access the system. Users input their username and password on the login page; the system verifies the credentials, grants access to the main dashboard if valid, and displays an error message if invalid. This process ensures secure and role-based access to the e-commerce system for all user categories—KOPTI, suppliers, retailers, and consumers. Figure 4 shows activity diagram of user login process.

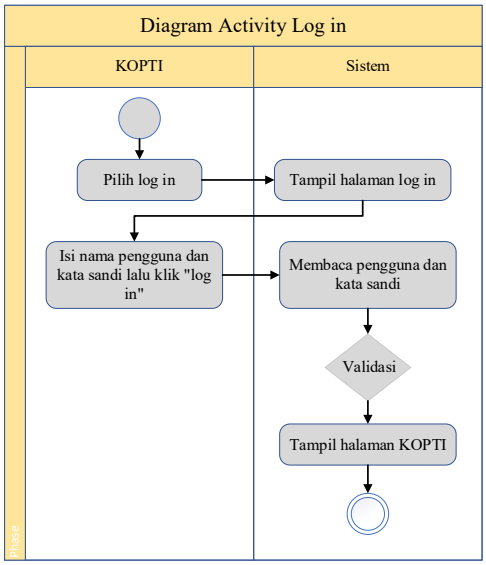


*Figure 4. Activity Diagram of User Login Process*

The Incoming Order Activity Diagram presents how KOPTI manages and processes customer orders. When entering the incoming order page, KOPTI can view a list of orders received from consumers or retailers. By selecting the "Process" option, the system can change the order status to "Processed" or "Shipped", and the system can monitor the fulfillment of the order in real-time. This activity demonstrates the system's ability to improve coordination across the soybean supply chain and streamline order handling. Figure 5 shows activity diagram of incoming order process.

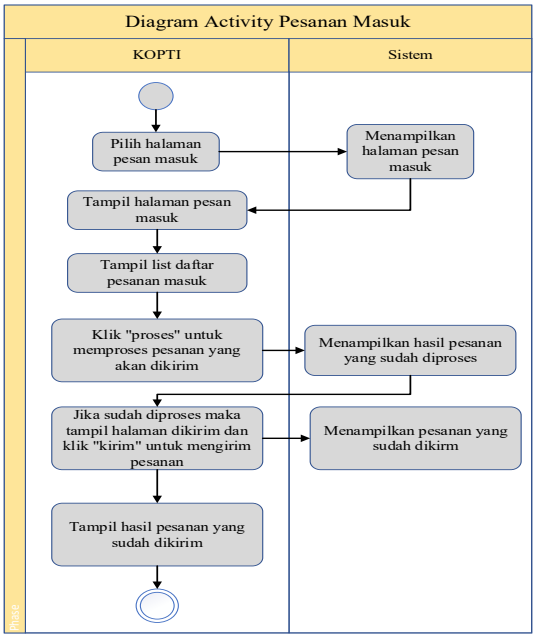


*Figure 5. Activity Diagram of Incoming Order Process*

3. Developing the prototype using website-based tools

The prototype was developed after the modeling stage using Adobe XD software. Then a design was carried out for the four main actors—KOPTI, Consumers, Retailers, and Suppliers—to visualize the user interface and transaction flow of the e-commerce system. Figure 6 illustrates KOPTI Sumedang website homepage.


*Figure 6. KOPTI Sumedang Website Homepage*

The homepage displays the logo, navigation menu, greetings, and login options for Admins, Suppliers, Consumers, and Retailers which function as the main entry point to the KOPTI Sumedang e-commerce system. The figure shows the Products page, including icons to view product details and a shopping cart icon for placing product orders. Figure 7 shows KOPTI Sumedang website product page.

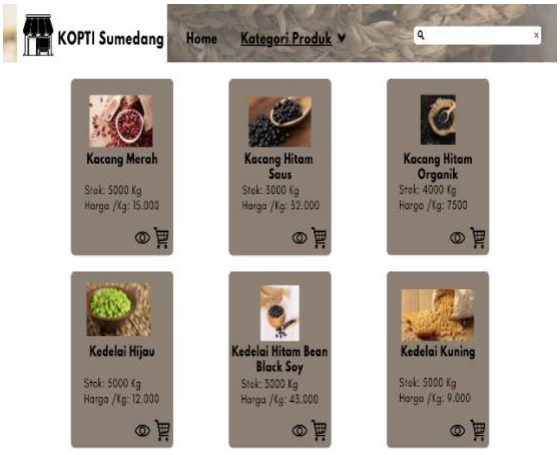


*Figure 7. KOPTI Sumedang Website Product Page*

4. Simulating and evaluating the prototype to assess functionality and usability.

After the development process is completed, the next stage is carried out through system simulation to ensure that each function runs according to its purpose and is easy to operate by the user. This simulation is focused on key user interactions that represent key activities in KOPTI Sumedang's supply chain, including system access, order management, and transaction completion.

Figure 8 shows the login interface for KOPTI, which serves as the main gateway for administrators to log into the system using a registered username and password. Users will be redirected to the main dashboard if the credentials entered are correct, while if the credentials are invalid, the system will display an error notification. This feature is intended to protect access and management of role-based e-commerce systems.

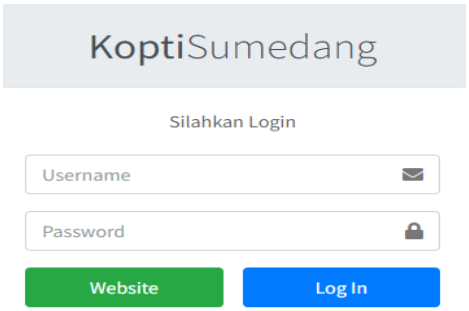


*Figure 8. Login Interface for KOPTI Sumedang*

The inbound order page for KOPTI is depicted in Figure 9. This allows the cooperative to monitor and supervise orders received from customers. All product details and customer information are included in each order entry. Once the order is verified, KOPTI can process it and update the delivery status to ensure that the product is packaged and delivered to the customer's registered address. This simulation illustrates how the system supports real-time coordination between KOPTI and its customers.

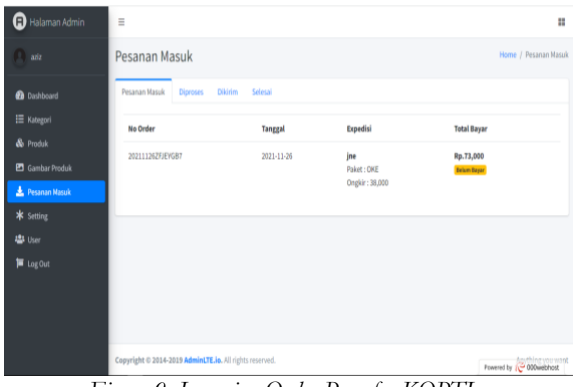


*Figure 9. Incoming Order Page for KOPTI*

Figure 10 illustrates the checkout page for consumers, which allows users to input delivery details such as province, city, courier service, package type, postal code, recipient name, and phone number. After filling out the form, the customer can confirm the purchase, and the system will automatically register the order data into the database. This stage guarantees an efficient customer transaction process through an integrated online workflow.

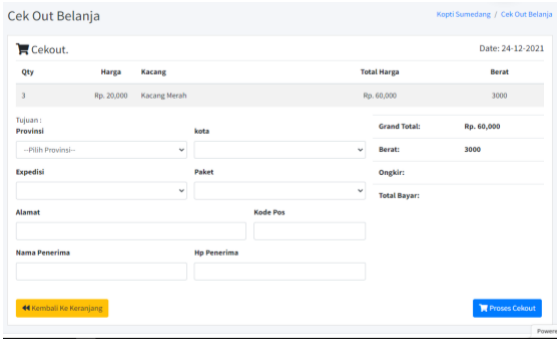


*Figure 10. Checkout Page for Consumers*

These simulation results indicate that the prototype effectively supports end-to-end supply chain processes—beginning with user login, order management by KOPTI, and order confirmation by consumers—demonstrating both system functionality and usability.

### 3.2. Discussion

The e-commerce prototype developed for KOPTI Sumedang successfully achieved the research goal, which is to improve supply chain efficiency, transparency, and market reach through digital integration. This system allows all parties — from suppliers, manufacturers, retailers, to consumers — to coordinate directly and in real time. Processes that were previously done manually and separately are now well integrated. Through digitalization in order management and product tracking, this system helps speed up the distribution of raw materials and reduce miscommunication, which used to be a major obstacle for KOPTI.

This research shows scientifically that the application of e-commerce platforms in cooperative-based supply chains can significantly improve operational performance. One of the key factors of supply chain effectiveness is improved data accuracy and responsiveness through the automation of the recording process, stock updates, as well as order processing. These findings align with Mu et al. (2021), who found that e-commerce-driven innovations improve coordination in two-stage supply chains, and with Kashurnikov et al. (2019), emphasizes the potential of e-commerce in optimizing supply chain operations in the context of Industry 4.0. Different from previous studies that focused on large-scale companies, this study highlights the application of e-commerce in community-based cooperatives, while offering a replicable model for MSME clusters in the agri-food sector.

In practical terms, this prototype plays a role in driving business expansion and digital transformation for small-scale business actors through the provision of a transparent and easily accessible online platform. The integrated system strengthens collaboration across the soybean supply chain and enhances KOPTI's competitiveness by enabling transactions to take place anytime and anywhere. These findings confirm that the developed system not only meets the needs of users, but also contributes to the sustainable digitalization of supply chains in the context of rural-based cooperatives.

## 4.CONCLUSION AND SUGGESTION

This study concludes that the design of a web-based e-commerce system for the KOPTI Sumedang supply chain has been successfully developed to support the interaction between import and local suppliers, producers, distributors, retailers, and end consumers. The system integrates three main flows in the supply chain, namely product flow, finance, and information. The designed website prototype allows users to log in, browse product catalogs, place orders and payments, and automatically record proof of transactions. The system helps monitor orders and determine the availability of raw materials, improving coordination throughout the supply chain.

E-commerce platforms facilitate access to product availability information, expand market reach, and improve operational efficiency by allowing transactions to be made anytime and anywhere without the need for a physical presence. This system helps KOPTI simplify the marketing process, expand its customer base, and accelerate the procurement of raw materials. Further research is suggested to optimize the overall performance of the supply chain by

adding the integration of automated payment gateways and real-time logistics tracking features.

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