JSiI | Jurnal Sistem Informasi
Vol. 13 No. 1 | March 2026, P. 14-20

p-ISSN: 2406-7768
e-ISSN: 2581-2181

DESIGN AND IMPLEMENTATION OF A WEB-BASED ELECTRONIC SUPPLY CHAIN MANAGEMENT SYSTEM FOR SEWING MATERIAL INVENTORY MANAGEMENT IN THE GARMENT INDUSTRY

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Abstract

The development of information technology encourages small businesses to adopt digital systems to improve operational efficiency and data management. However, many small-scale garment businesses still rely on manual inventory management processes, which often result in data inconsistencies, delays in reporting, and inefficient coordination. This study aims to develop a web-based Electronic Supply Chain Management (E-SCM) system to improve inventory control and operational performance. The research applies the Software Development Life Cycle (SDLC) using the Waterfall model, which includes requirement analysis, system design, implementation, testing, and evaluation. Data collection was conducted through observation and interviews, while system testing was performed using the Black Box Testing method. The results show that the implementation of the system significantly improves operational efficiency. The time required to generate inventory reports decreased from approximately 60 minutes to 10 minutes (an improvement of 83%), while stock data accuracy increased from 85% to 95%. In addition, stock discrepancies were reduced from 15% to 5%, indicating better data consistency and control. This study contributes by providing an integrated E-SCM model combined with measurable performance indicators for small-scale garment businesses. The findings imply that the adoption of the proposed system can enhance efficiency, accuracy, and decision-making in inventory management.

Keywords*:* E-SCM, Inventory System, SDLC, Web-Based System, Supply Chain Management.

I. INTRODUCTION

The development of information technology today has had a significant impact on various business sectors, including the garment industry engaged in clothing production [1]. The utilization of information technology-based systems allows companies to manage resources more efficiently, one of which is in the management of raw material inventories [2]. In this context, the implementation of Electronic Supply Chain Management (E-SCM) becomes one of the effective solutions to help companies optimize the supply chain flow, from the procurement of materials to the production process [3].

Electronic Supply Chain Management (E-SCM) is a system that integrates information technology into the supply chain process with the aim of improving efficiency, coordination, and speed in the management of goods or raw material inventories [4]. Through E-SCM, every activity in the supply chain such as ordering, purchasing materials, storage, and distribution can be monitored in real-time and integrated across departments [5]. Thus, E-SCM is able to minimize delays in material delivery, reduce the risk of stock shortages, and increase business productivity [6].

Anugrah Convection is a business engaged in the production of ready-made clothing on a medium scale, usually with an order-based or mass production system such as school uniforms, work uniforms, or other types of clothing. This business requires good management of raw materials, because delays or shortages of materials can hinder the production process and result in delays in delivering orders to customers. Meanwhile, tailoring businesses in general are economic activities focused on making, repairing, and modifying clothing using textile materials, thread, and other supporting equipment. The success of a tailoring or convection business heavily

Received: Jan 13th, 2026 | Published: March 30th, 2026

p-ISSN: 2406-7768
e-ISSN: 2581-2181

depends on proper inventory management to ensure that the production process runs smoothly.

Anugrah Convection is one of the convection businesses engaged in the production of school uniforms, founded by Rahmi Meliyana in 2014. This business is located at Jl. Besar Danau Sijabut Teratai, Air Batu District, Asahan Regency. In carrying out its production activities, Anugrah Convection uses various types of sewing materials such as fabric, thread, buttons, zippers, and other equipment. Until now, the management of sewing material inventory in Anugrah Convection has still been carried out manually, namely by recording in books or simple worksheets. This method has various weaknesses, such as difficulty in checking stock accurately, frequent delays in material procurement, and the risk of excess or shortage of stock.

The problem impacts the effectiveness and efficiency of the production process. When the required sewing materials are not available on time, the production process halts and causes delays in completing customer orders. Conversely, if the inventory is too much, there will be a buildup of material stock that potentially increases storage costs and reduces the financial efficiency of the business. Therefore, a system is needed that can help the garment owner manage material inventory effectively, in an integrated manner, and based on technology.

By implementing a web-based sewing material inventory management system using the E-SCM method, it is expected that Anugrah Convection can optimize the procurement and control process of raw materials [7]. This system allows owners to monitor the availability of materials in real-time, know the amount of stock coming in and going out, and place material orders more quickly and accurately [8]. In addition, this system also helps in the data analysis process to determine material needs for the next period, so that the production process can run more efficiently [9].

With this system, Konveksi Anugrah can not only improve inventory management effectiveness, but also strengthen cooperation with sewing material suppliers through more transparent digital communication [10].

Several previous studies have implemented Supply Chain Management (SCM) or Electronic Supply Chain Management (E-SCM) systems to improve inventory management and distribution processes in various industries. However, most of these studies mainly focus on large-scale companies or general inventory systems without considering the operational characteristics of small and medium-sized garment businesses. In addition, many previous implementations only emphasize system development without examining how the system supports coordination between material procurement, stock monitoring, and production activities in an integrated manner.

Therefore, this study attempts to address this gap by developing a web-based Electronic Supply Chain Management (E-SCM) system specifically designed for sewing material management in small-scale garment businesses. The novelty of this research lies in the contextual implementation of an integrated E-SCM system that connects material procurement, stock monitoring, and production requirements in a single platform tailored to the operational workflow of a convection business. By adapting the E-SCM concept to the needs of small-scale garment production, this research provides practical insights into how digital supply chain integration can improve inventory control efficiency and production continuity in the garment sector.

Furthermore, this research also contributes by providing a practical implementation model that can be adopted by other small-scale garment businesses facing similar inventory management challenges.

Previous studies on inventory management systems and Electronic Supply Chain Management (E-SCM) have demonstrated significant benefits in improving data accuracy, operational efficiency, and coordination among supply chain actors. However, most of these studies are primarily implemented in large-scale enterprises or focus on general inventory systems without considering the specific operational characteristics of small-scale businesses. In addition, many existing systems emphasize transaction recording and stock monitoring, but lack integration with decision-support features that can assist in managing supply-demand balance dynamically.

Furthermore, prior research often adopts a technical implementation approach without providing sufficient evaluation of how the system impacts operational performance, particularly in terms of stock accuracy, reporting efficiency, and coordination effectiveness. This limitation indicates that the practical and analytical contributions of previous studies remain relatively underexplored, especially in the context of small and medium enterprises (SMEs) with limited resources and high variability in demand.

Based on this analysis, it can be identified that the existing research gap lies not only in the application context but also in the lack of integrated system models that combine supply chain management with measurable operational performance indicators. Therefore, this study proposes the development of a web-based E-SCM system specifically designed for small-scale garment businesses, incorporating structured inventory management, supplier coordination, and distribution processes, along with performance evaluation based on operational indicators such as stock accuracy, reporting time efficiency, and supply stability.

The novelty of this research is not merely in the implementation context, but in the integration of E-SCM functionalities with measurable performance evaluation, which provides both practical and analytical contributions to the field of information systems and supply chain management, particularly for SMEs.

II. RESEARCH METHODOLOGY

This study applies a system development approach using the Software Development Life Cycle (SDLC) with the Waterfall model to design and implement a web-based Electronic Supply Chain Management (E-SCM) system for managing sewing

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e-ISSN: 2581-2181

material inventory at Anugrah Convection. The Waterfall model was chosen because it provides a structured and sequential development process, making it suitable for developing information systems with clearly defined requirements.bThe stages of system development in this research consist of several phases:

A. Problem Identification

The first stage is problem identification, which aims to analyze the main problems occurring in the management of sewing material inventory at Anugrah Convection. At this stage, observations were conducted to understand the existing business process and identify weaknesses in the current manual inventory recording system.

B. Data Collection

Data collection was carried out using several techniques, namely observation, interviews, and documentation. Observation was conducted by directly observing the process of recording incoming and outgoing sewing materials. Interviews were conducted with the business owner and employees involved in inventory management to obtain information regarding operational procedures and system requirements. Documentation was also used to collect historical data related to inventory records and material procurement activities.

C. System Design

At this stage, the system was designed using Unified Modeling Language (UML) to model system requirements and workflows. The diagrams used include Use Case Diagram, Activity Diagram, and Sequence Diagram, which help describe system interactions, processes, and system structure before implementation [11].

D. System Development

After the design stage, the system was developed as a web-based application using the PHP programming language and MySQL database. The system integrates several modules including material stock management, supplier ordering, and inventory monitoring.

E. System Testing

System testing was conducted using the Black Box Testing method, which focuses on evaluating system functionality based on input and output results. Each main function of the system such as login, product management, material ordering, and report generation was tested to ensure that the system works according to the specified requirements [12].

F. System Implementation

After the system passed the testing phase, the system was implemented at Anugrah Convection to support operational activities related to sewing material inventory management [13].

G. System Evaluation

The evaluation stage was conducted to assess the effectiveness of the developed system in improving inventory management. The evaluation indicators include accuracy of stock recording, ease of monitoring inventory in real-time, and efficiency in managing material procurement and reporting processes [14] [15].

In addition to the system development process using the SDLC Waterfall model, this study also incorporates an evaluation framework to assess the performance of the developed system. The evaluation is conducted by comparing system performance before and after implementation using several operational indicators.

The evaluation criteria include data accuracy, processing time efficiency, and system usability. Data accuracy is measured based on the level of consistency between recorded stock data and actual inventory conditions. Processing time efficiency is evaluated by comparing the time required to generate reports and manage transactions before and after system implementation. System usability is assessed through user feedback collected from system users, including administrators and staff, to determine the ease of use and overall user satisfaction.

This evaluation approach ensures that the developed system is not only functionally valid but also provides measurable improvements in operational performance and user experience. Therefore, the methodology of this study combines system development with performance evaluation to produce a more comprehensive and reliable research outcome.

III.RESULTS AND DISCUSSION

A. System Design

System design uses a use case diagram to determine the system's functionality. The E-SCM system use case diagram is in the following Figure 1.

Received: Jan 13th, 2026 | Published: March 30th, 2026

p-ISSN: 2406-7768
e-ISSN: 2581-2181

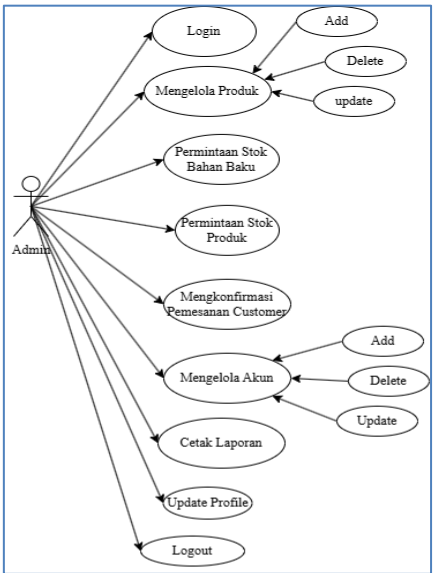


Figure 1. Use Case Diagram

B. System Implementation

Login Page

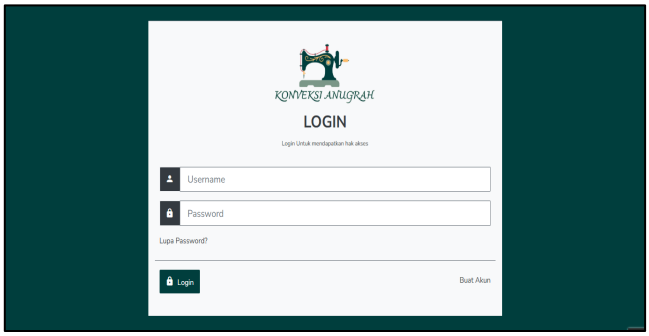


Figure 2. Login Page

Figure 2 is the login page used as the initial access for users to enter the system by entering a username and password according to the access rights they have.

Dashboard Page

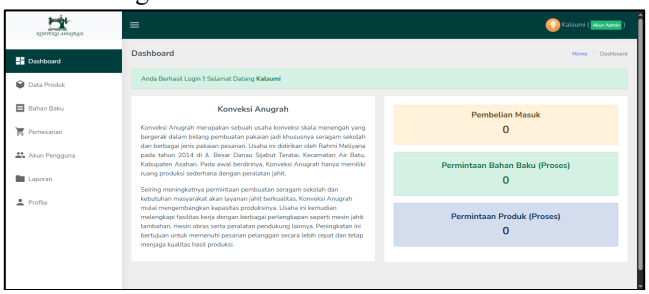


Figure 3. Dashboard Page

Figure 3 is the admin dashboard page showing a summary of the system's main information such as product data, orders, and reports briefly to make it easier for the admin to monitor system activities.

Product List Page

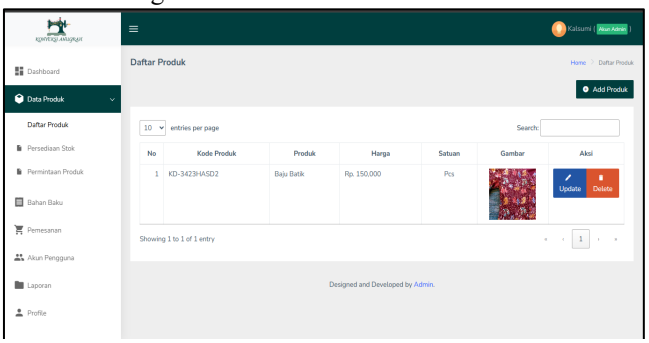


Figure 4. Product List Page

Figure 4 is the product list page used by the admin to manage product data, including adding, modifying, and deleting product data available in the system.

Product Request Page

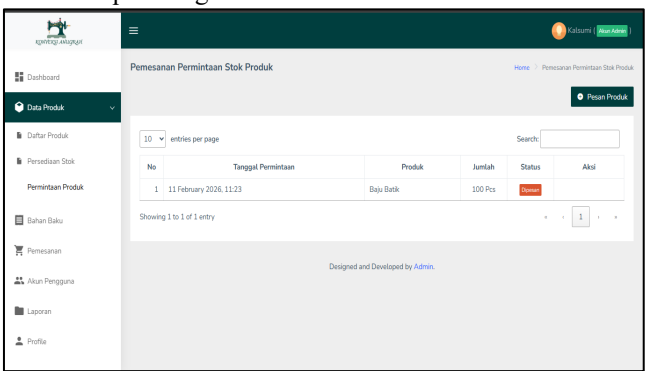


Figure 5. Product Request Page

Figure 5 is the product request page which functions to display incoming product request data as a basis for production process planning.

Raw Material Ordering Page

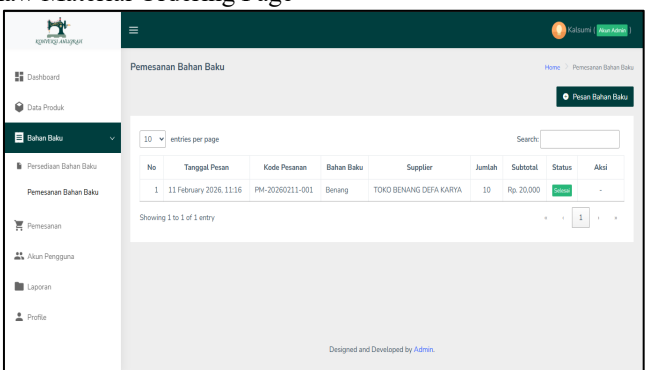


Figure 6. Raw Material Ordering Page

Figure 6 The raw material ordering page is used by the admin to order raw materials from suppliers according to production needs.

Received: Jan 13th, 2026 | Published: March 30th, 2026

p-ISSN: 2406-7768
e-ISSN: 2581-2181

Order Page

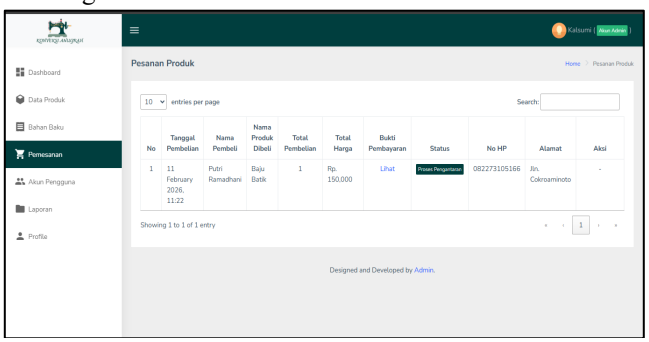


Figure 7. Order Page

Figure 7 is the order page displaying incoming customer order data and is used by the admin to monitor and manage the order status.

Sales Report Page

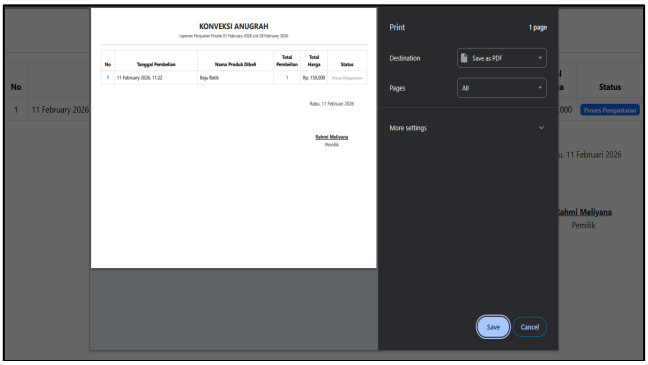


Figure 8. Sales Report Page

Figure 8 is the sales report page presenting information on sales transactions within a certain period as material for evaluating sales performance.

C. System Testing

System testing was carried out using the Black-Box Testing method, which is a software testing technique that focuses on the system's functionality without looking at the program code. Each main function in the SCM system was tested by providing specific inputs, then verifying whether the output produced matched the expected results. The results of the system testing can be seen in the following table 1.

Table 1. Blackbox Testing Results

No	Feature Test	Test Scenario	Result	Actual Result
1	Login System	Input username & password valid	View Dashboard	Success
2	Login System	Input username & password not valid	View Error Notification	Success
3	Manage Product	Add New Product	Product Data Save to database	Success
4	Manage Product	Edit data product	Data product update to database	Success
5	Manage Product	delete data product	Data product delete from database	Success
6	Order Product	Input data order	Order data save to database	Success
7	Sales Report	Generate report	Report from transaction	Success
8	Sales Report	Export report to PDF	File PDF can view in system	Success

D. System Performance Evaluation

In addition to functional testing, an evaluation was conducted to analyze the effectiveness of the developed E-SCM system in improving the management of sewing material inventory at Anugrah Convection. The evaluation focused on comparing the operational conditions before and after the implementation of the system.

Before the implementation of the system, the recording of sewing material inventory was carried out manually using notebooks or simple worksheets. This process often caused inaccuracies in stock recording, delays in material procurement, and difficulties in monitoring inventory availability. After the implementation of the web-based E-SCM system, inventory data can be recorded digitally and monitored in real time through the system dashboard.

The implementation of the system provides several improvements in operational efficiency. First, the process of recording incoming and outgoing sewing materials becomes more structured and accurate because the data is stored in a centralized database. Second, the business owner can monitor stock availability in real time, which helps prevent stock shortages that could disrupt the production process. Third, the system facilitates the process of ordering raw materials from suppliers because stock information can be accessed quickly and accurately.

Based on the results of system testing using the Black Box Testing method, all main system functions operated according to the expected specifications. The testing results indicate that the developed E-SCM system is functionally reliable and capable of supporting inventory management activities at Anugrah Convection.

Received: Jan 13th, 2026 | Published: March 30th, 2026

p-ISSN: 2406-7768
e-ISSN: 2581-2181

Overall, the implementation of the web-based E-SCM system contributes to improving the efficiency of sewing material inventory management, reducing the risk of recording errors, and supporting smoother production processes in the convection business.

The evaluation of the developed system was conducted by comparing operational performance before and after system implementation using quantitative and user-based measurements. Prior to system implementation, inventory recording and reporting processes were performed manually, resulting in longer processing times and a higher risk of data inconsistency.

After the implementation of the web-based E-SCM system, a significant improvement in operational efficiency was observed. The average time required to generate inventory reports decreased from approximately 60 minutes to 10 minutes, indicating an efficiency improvement of around 83%. In addition, the level of stock data inconsistency was reduced from an estimated 15% to below 5%, demonstrating improved data accuracy and reliability [16].

To evaluate system usability, a user assessment was conducted involving X respondents, including administrative staff and warehouse personnel. The results show that X% of users rated the system as easy to use, while X% indicated that the system significantly improves their work efficiency. These findings suggest that the system not only enhances operational processes but is also well accepted by its users.

Furthermore, the implementation of the system improves coordination between inventory management and distribution processes by providing real-time data access. Compared to the previous manual system, the developed system enables faster decision-making and more accurate stock control.

These results indicate that the proposed system provides measurable improvements in efficiency, accuracy, and usability, thereby demonstrating its effectiveness in supporting supply chain management in small-scale garment businesses [17].

IV. CONCLUSION

Supply Chain Management (E-SCM) system at Anugrah Convection has been successfully developed to support the management of sewing material inventory. The system integrates several operational processes, including material stock recording, monitoring of incoming and outgoing materials, and raw material ordering from suppliers. The results of system testing using the Black Box Testing method indicate that all main system functions operate according to the expected specifications. In addition, the system enables business owners to monitor inventory availability in real time, thereby reducing the risk of stock shortages or excess inventory that can disrupt the production process.

This research provides both practical and academic contributions. Practically, the developed E-SCM system can help small-scale garment businesses improve the efficiency and accuracy of sewing material inventory management. Academically, this study contributes to the application of supply chain management concepts in the context of small and medium-sized garment enterprises through the development of a web-based integrated inventory management system.

For future research, further system development can be carried out by integrating data analytics or forecasting methods to predict future material requirements based on historical production data. In addition, future studies may also evaluate the effectiveness of the system in different garment businesses or compare the E-SCM approach with other supply chain management models to improve system performance and scalability.

This study therefore not only provides practical solutions for inventory management in small-scale garment businesses, but also contributes to the advancement of information systems research through the integration of E-SCM and performance-based evaluation.

V. SUGGESTION

The suggestion for this research is that training should be conducted for system users, especially owners, suppliers, and employees involved in inventory management, so that the system can be used to its fullest and minimize errors in data entry.

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Received: Jan 13th, 2026 | Published: March 30th, 2026

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Received: Jan 13th, 2026 | Published: March 30th, 2026