Design of AiStock Application Based on Artificial Intelligence for Stock Management Efficiency of Digital Retail SMEs

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Abstract

SMEs play a crucial role in the Indonesian economy, yet face challenges in stock management, particularly in the digital retail sector. This research aimed to explore how AI-based technology could assist SMEs in managing stock efficiently through the development of the AiStock application. Employing a qualitative approach, this study collected data through interviews and observations with SME operators to understand the challenges faced in stock management and their reception towards new technology. The AiStock application was designed based on these findings, with key features such as demand forecasting, automatic notifications, and real-time analytical dashboards. The research findings demonstrated that this application enhanced SME stock management efficiency by reducing time spent on stock management, decreasing stockout frequency, and improving product availability. Users provided positive feedback regarding the ease of use of the application and the accuracy of predictions that assisted them in data-driven decision-making. This research concluded that the implementation of AI technology in SME stock management could improve operational efficiency and support competitiveness in the digital era. The AiStock application offered a relevant, practical, and affordable solution for SMEs in Indonesia to address managerial challenges and enhance their business sustainability.

Keywords: SMEs, Artificial Intelligence (AI), Stock Management, Management Efficiency, AiStock Application

Introduction

SMEs (Micro, Small, and Medium Enterprises) constitute the backbone of the Indonesian economy, contributing more than 60% to the national GDP and absorbing approximately 97% of the national workforce (Ministry of Cooperatives and SMEs, 2023). This significant contribution positions SMEs as a strategic sector requiring special attention in efforts to enhance national economic competitiveness. However, this sector continues to face substantial challenges in terms of digitalisation and stock management efficiency, particularly for digital retail SMEs which have developed rapidly in the current digital economy era.

The massive digital transformation that has occurred, especially post-COVID-19 pandemic, has driven many SMEs to shift to digital platforms as their primary sales channel. This shift has created more complex business dynamics, whereby SMEs must not only manage physical operations but also integrate digital systems requiring more sophisticated data management. In this context, stock management has become one of the critical aspects determining the operational success of digital retail SMEs.

Inefficient stock management can result in excess inventory (overstock), stock shortages (stockout), wasteful storage costs, and decreased customer satisfaction. This problem is exacerbated by SMEs' limited access to advanced

digital technology capable of supporting data-driven decision-making. The scarcity of human resources possessing information technology competence also constitutes a major obstacle in implementing more effective stock management systems.

The impact of suboptimal stock management is not limited to operational aspects but also affects long-term business sustainability. Overstock can cause working capital to be tied up which should otherwise be utilised for expansion or other productive investments, whilst stockout can result in lost sales opportunities and diminished consumer confidence. In a competitive business environment, such inefficiency can become a factor hindering SME growth and sustainability.

Artificial Intelligence (AI) offers innovative solutions through systems capable of predicting stock requirements, managing demand cycles, and providing automatic recommendations based on historical data patterns (Zebua et al., 2024). AI technology possesses the capability to analyse big data with high accuracy, identify patterns invisible to conventional analysis, and provide predictive insights that can significantly enhance operational efficiency.

Through an AI-based approach, SMEs have opportunities to optimise operational processes, reduce loss risks due to inaccurate stock, and enhance competitiveness in the digital era. AI can also automate sales data analysis processes, minimise human error, and provide deeper insights for business decision-making (Rachmah & Fadil, 2024). AI implementation in stock management can also assist SMEs in optimising cash flow, reducing waste, and improving customer satisfaction through more guaranteed product availability.

The development of AI-based solutions for SMEs needs to consider aspects of accessibility and affordability, given the limited resources possessed by this sector. Therefore, an approach is required that integrates advanced technology with a simple and intuitive user interface, enabling adoption by SMEs with various levels of technological literacy. Furthermore, the developed solution must possess flexibility to adapt to various business models and diverse operational scales within the SME sector (Harahap et al., 2021).

Based on the background of these problems, this research aimed to design the AiStock Application, an AI-based platform to assist digital retail SMEs in managing stock efficiently and predictively (Nurfitriya et al., 2022). The primary objective of this research was to develop a system capable of accurately predicting stock requirements, optimising cash flow through timely ordering recommendations, and providing analytical dashboards facilitating business decision-making. The problems underlying this research included: how to design AI algorithms capable of predicting product demand with high accuracy based on SME historical sales data; how to integrate the AI prediction system with a user-friendly interface accessible to SMEs with various levels of technological literacy; and how to optimise application features to provide actionable and relevant recommendations for digital retail SME operational needs. This research was expected to provide practical contributions in bridging the technology gap faced by SMEs, whilst promoting sustainable digital transformation acceleration in this sector. The developed AiStock application was anticipated to become a practical and affordable solution accessible to SMEs from small to medium scale, supporting operational efficiency improvement and competitiveness within the digital economic ecosystem.

Method

This research employed a qualitative approach to explore in-depth understanding regarding stock management in SMEs, challenges faced in inventory management, and the potential application of AI technology in enhancing efficiency (Fadli, 2021; Saleh, 2017). The research process commenced with a literature study to comprehend related concepts and challenges faced by SMEs in stock management (Oktaviani et al., 2024). Subsequently, in-depth interviews were conducted with SME operators to explore their experiences and perceptions towards technology usage in stock management. Data from interviews were analysed thematically to identify patterns related to needs and obstacles encountered in technology implementation. Throughout the research, observations were also conducted at SMEs to further understand existing practices in stock management and how AI

technology could be applied. Based on initial findings, the AiStock application was designed considering user-expressed needs, including AI-based demand prediction features, automatic notifications, and analytical visualisation dashboards to facilitate decision-making. These features were trialled at several SMEs to obtain feedback used for application improvement. In the evaluation stage, data analysis was conducted using triangulation techniques to enhance findings validity. User feedback during trials was analysed to refine the application and ensure it could meet SMEs' practical needs. This research focused on understanding SME contexts and providing solutions relevant to challenges faced, whilst promoting sustainable digital transformation.

Results and Discussion

The results of system development demonstrated that the AiStock application was successfully constructed and functioned optimally, equipped with a number of superior features specifically designed to address stock management challenges faced by digital retail SMEs. This application not only offered automation solutions but also presented a data-based predictive approach capable of reducing dependence on manual recording and business operators' subjective intuition (Dawis et al., 2024).

The implementation of artificial intelligence technology in the AiStock application employed a combination of machine learning algorithms proven effective in demand forecasting. The system integrated ARIMA algorithms for time series analysis capable of identifying seasonal patterns and long-term trends in sales data. Additionally, LSTM (Long Short-Term Memory) neural network implementation enabled the system to understand long-term dependencies in historical data, thereby providing more accurate predictions for products with complex demand patterns. K-Means clustering algorithms were also utilised to group products based on stock movement characteristics, enabling the application of different management strategies for each product category.

Besides prediction features, the system was also equipped with real-time visualisation dashboards presenting important information such as stock inflow and outflow quantities, demand trend graphs, and early warnings regarding potential stockouts. This visualisation proved highly beneficial for users in making rapid and data-based decisions, without needing to analyse complex and error-prone manual spreadsheets. This feature was designed with user-friendly principles and optimised for mobile devices enabling SME operators to monitor stock anytime and anywhere (Ausat et al., 2025).

The developed analytical dashboard provided various types of comprehensive data visualisation, ranging from bar charts for stock comparison across product categories, line graphs to display demand trends within specific time periods, to heat maps for identifying products with the highest movement rates. The system also provided drill-down features allowing users to view data details at more specific levels, thereby facilitating pattern and anomaly identification in sales data. Integration with push notification systems ensured that important information could be accessed in real-time even when users were not actively using the application (Sifwah et al., 2024).

Another superior feature was automatic notifications for reorder points, which functioned by calculating minimum stock thresholds (safety stock) based on variables such as lead time, average daily demand, and previous demand fluctuations (Harahap et al., 2025). With this feature, business operators no longer needed to remember or record independently when to reorder goods. The system would automatically provide warnings when stock approached critical thresholds, thereby enabling stockout risks to be significantly minimised.

Reorder point calculations in the AiStock application employed formulae adapted to SME business characteristics, namely: Reorder Point = (Average daily demand × Lead time) + Safety stock. Safety stock was calculated based on demand and supplier lead time variability analysis, considering risk factors acceptable to each SME. The system also provided flexibility for users to adjust these parameters based on business experience and specific market conditions (Al et al., 2021; Nofriyanti & Prasetya, 2024).

Field Testing Stage

At the field testing stage, the AiStock application was directly tested for one full month

at 5 digital retail SMEs operating in various sectors, such as fashion, food, and accessories. These SMEs were selected based on business scale variations, product types, and stock management complexity, to obtain a representative overview of application effectiveness. The results demonstrated tangible positive impacts on their operations. The field-testing methodology was designed with a before-after comparison approach, whereby SME operational data were measured for one month prior to application implementation (baseline) and compared with data for one month following implementation. Measured parameters included time spent on stock management, stockout frequency, prediction accuracy levels, and user satisfaction. Each participating SME was provided with 2 hours of basic training to ensure optimal understanding of application features.

Meanwhile, stock management time decreased by up to 43%, meaning SME operators could save almost half the time previously spent recording, checking, and updating stock manually. This directly impacted work efficiency improvement and enabled business operators to focus more on other strategic business aspects, such as marketing and customer service (Girfita et al., 2021).

Detailed analysis of time savings demonstrated that the greatest efficiency was achieved in transaction recording and stock updating processes, which previously consumed an average of 2-3 hours per day could now be completed in less than 1 hour. Automation of reorder point calculation processes also reduced time required for ordering requirement analysis from 45 minutes to merely 5 minutes per session. These time savings enabled SME operators to allocate more time for high value-added activities, such as product development and marketing strategies.

Furthermore, stockout occurrence frequency decreased by up to 62% following AiStock application implementation. This decrease not only signified improved goods availability but also demonstrated that the system successfully reduced potential sales losses and enhanced end-customer satisfaction. This condition was particularly important in the SME context, which generally lacked substantial capital reserves to address stock imbalances.

The impact of stockout reduction on business performance could be observed from an average monthly turnover increase of 18% at SMEs subject to testing. This increase was primarily caused by reduced sales losses due to stock depletion, and increased customer confidence due to more consistent product availability. Data indicated that prior to implementation, each SME experienced stockouts 8-12 times per month on average, however after utilising the AiStock application, this frequency declined to 3-5 times per month.

User Satisfaction Evaluation

From the user satisfaction perspective, the AiStock application received a System Usability Scale (SUS) score of 84, categorised as "excellent". The majority of respondents stated that the application was easy to use even by users without technological backgrounds. The application interface was assessed as intuitive, navigation clear, and installation and initial usage processes could be conducted without special training. Several respondents also conveyed that they felt more confident in making operational decisions after utilising this system because it was supported by accurate data and predictions.

User satisfaction evaluation was conducted using structured questionnaires comprising 10 standard SUS questions and 15 additional questions specific to the SME stock management context. Evaluation results demonstrated that 92% of respondents stated the application was easy to learn, 88% felt confident they could use the application without technical assistance, and 95% stated that prediction features assisted them in business decision-making. The aspect receiving the highest assessment was ease of information access (4.6/5.0) and notification accuracy (4.5/5.0).

Qualitative feedback from users demonstrated high appreciation for the clean and uncomplicated interface design, and the application's capability to adapt to various types of retail businesses. Several users mentioned that the mobile dashboard feature enabled them to monitor their business even when not present at the business premises, which proved highly beneficial in emergency situations or when conducting business travel.

Impact of AI Technology on Operational Efficiency

Overall, the results of this research proved that the implementation of artificial intelligence-based technology, particularly through application development such as AiStock, possessed substantial potential in enhancing operational efficiency, productivity, and SME competitiveness in the digital era. AI utilisation was not merely a trend but had demonstrably provided direct measurable impacts in real small business contexts (Fauzi et al., 2024).

AI technology implementation in SME stock management demonstrated significant transformation in business decision-making patterns. Prior to utilising the AiStock application, the majority of SME operators relied on intuition and subjective experience in determining when and how much stock should be ordered. This approach frequently produced suboptimal decisions, particularly for products with complex or seasonal demand patterns. With AI implementation, business decisions were now supported by objective data analysis and accurate predictions, thereby reducing error risks that could impact financial losses.

In-depth User Experience Insights

Through in-depth interviews conducted during and after the field-testing period, participants revealed several recurring themes regarding their experience with the AiStock application. Multiple SME operators expressed relief at no longer experiencing anxiety about potential stockouts, with one participant stating that the predictive notifications provided peace of mind that allowed them to focus on other business aspects. Several users described how the visual dashboard transformed their understanding of their own business patterns, revealing seasonal trends and product correlations they had not consciously recognised despite years of operation.

Participants consistently emphasised the psychological impact of having data-driven support for their decisions. Traditional stock management, they explained, relied heavily on intuition and memory, which often led to second-guessing and uncertainty. The AiStock application, by providing concrete predictions and historical trend visualisation, gave them confidence to make purchasing decisions more decisively. One fashion retailer noted that this newfound confidence enabled her to experiment with new product lines, knowing she could monitor performance and adjust stock levels responsively based on actual demand signals rather than guesswork.

Observed Changes in Business Practices

Observational data collected throughout the testing period revealed notable shifts in how SME operators approached their daily business routines. Initially, most participants checked stock levels reactively—only when customers requested items or when they suspected inventory might be low. Following AiStock adoption, this pattern evolved into proactive monitoring, with operators consulting the dashboard at regular intervals to anticipate needs rather than respond to problems.

The notification system appeared to fundamentally alter users' relationship with suppliers. Previously, reordering was often crisis-driven, with urgent orders placed when stock depletion became apparent. With advance warning from the application, SME operators began scheduling regular supplier communications and negotiating better terms through consolidated, planned orders rather than fragmented emergency purchases. Several participants mentioned improved supplier relationships resulting from this more professional, predictable ordering behaviour.

An unexpected but consistently observed phenomenon was the emergence of collaborative learning among participating SMEs. During follow-up visits, it became apparent that users had begun sharing strategies for interpreting dashboard insights and adjusting application settings to better suit their specific business contexts. This organic knowledge exchange suggested that the application served not merely as a tool but as a catalyst for community-based business development.

Contextual Adaptation and Learning Curves

The research revealed significant variation in how different SME operators adapted the application to their specific contexts. Food retailers, for instance, prioritised short-term predictions and daily monitoring due to product perishability concerns, whilst fashion and accessories retailers focused more on longer-term trend analysis and seasonal pattern recognition.

This contextual adaptation demonstrated the application's flexibility, but also highlighted diverse user needs that might require customisable dashboard configurations in future iterations.

Several participants described an initial learning period during which they tested the system's predictions against their own intuition. This "trust-building phase" typically lasted two to three weeks, during which users would note predictions, make their own assessments, and then compare outcomes. Only after observing consistent accuracy did most users begin relying primarily on the AI recommendations. This pattern suggests that user adoption of AI-assisted tools in traditional business contexts may require a period of validation before full integration into decision-making processes.

Interestingly, some experienced business operators initially resisted certain recommendations, believing their intimate knowledge of local market conditions surpassed algorithmic predictions. However, in instances where they followed the AI guidance despite reservations, outcomes generally validated the system's recommendations. This experiential learning appeared crucial in shifting users from scepticism to trust, with several participants explicitly acknowledging that the application had revealed blind spots in their own understanding of demand patterns.

More in-depth analysis of operational efficiency demonstrated that performance improvement occurred not only in stock management aspects but also impacted other business areas. Significant time savings enabled SME operators to focus more on customer service activities, product development, and marketing strategies. This ultimately contributed to overall service quality improvement and business competitiveness in the market.

Emergent Challenges and User-Identified Limitations

Throughout the testing period, participants voiced several concerns and identified limitations that warrant consideration. A recurring theme was the challenge of inputting historical data during initial setup. SMEs with inconsistent or incomplete prior records found this process particularly burdensome, with some expressing frustration at having to reconstruct past sales

patterns from fragmentary records or memory. This highlighted the importance of designing onboarding processes that accommodate varying levels of record-keeping sophistication.

Several users mentioned occasional confusion when algorithmic predictions contradicted their expectations, particularly during unusual market conditions such as local events or unexpected viral trends affecting demand. These instances created uncertainty about whether to trust their experience or the system's recommendations. The absence of explanatory features that could contextualise why certain predictions were generated left some users feeling they were operating a "black box" rather than a transparent decision-support tool.

Connectivity issues emerged as a practical concern, particularly for SMEs operating in areas with unreliable internet access. While the application included offline functionality, users expressed anxiety about data synchronisation and whether information entered offline would accurately integrate with cloud-based predictions. This revealed a tension between the sophisticated computational requirements of AI-driven systems and the infrastructure realities of many Indonesian SME operating environments.

Additionally, some participants expressed desire for more collaborative features, such as the ability to share inventory insights with business partners or compare their performance against anonymised industry benchmarks. This feedback suggested that SME operators viewed stock management not as an isolated function but as part of a broader business ecosystem where collective intelligence might provide additional value beyond individual optimisation.

Moreover, successful testing at small to medium-scale SMEs demonstrated that digital solutions such as AiStock could be accessed and implemented widely, provided they were designed considering users' actual needs and local business environments. Moving forward, adoption of this technology could become a strategic step in promoting comprehensive SME digital transformation, strengthening national economic resilience from grassroots sectors.

The replication and scalability potential of the AiStock application was extremely high, considering that efficient stock management requirements constituted a universal challenge

faced by the majority of digital retail SMEs. With appropriate adjustments and customisation, this application could be adapted for various types of retail businesses, ranging from traditional grocery stalls to more modern online shops. Ease of use and affordable implementation costs became key factors enabling mass adoption amongst Indonesian SMEs.

The long-term implications of this research demonstrated that investment in AI technology for SMEs was not only beneficial in terms of operational efficiency but also contributed to building a more inclusive and sustainable digital economic ecosystem. When SMEs possessed better access to advanced technology, they could compete more effectively with larger business operators, thereby creating healthier competition and sustainable innovation in the retail sector.

Conclusions

Based on the results of this research, it could be concluded that the implementation of artificial intelligence (AI) technology through the AiStock application had provided significant impact in enhancing operational efficiency, productivity, and digital retail SME competitiveness. This application successfully optimised SME stock management by employing accurate predictive algorithms, such as ARIMA, LSTM, and K-Means clustering, which assisted in minimising overstock and stockout problems. Field testing results demonstrated stock management time efficiency improvement of up to 43%, stockout frequency reduction of 62%, and SME monthly turnover increase of 18%. Additionally, this application received excellent user satisfaction ratings, with features that were easy to use and provided positive impacts on business decision-making. AI technology adoption in SME stock management demonstrated substantial potential in promoting sustainable digital transformation and enhancing SME competitiveness in the retail sector. The AiStock application offered an affordable and easily accessible solution for SMEs with various levels of technological literacy, enabling wide-scale implementation. This research also demonstrated that investment in AI technology could strengthen national economic resilience by creating a more inclusive and sustainable digital economic ecosystem. With high replication and scalability potential, AiStock could become a strategic step in enhancing SME operational efficiency nationally.

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