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An Integrated Safety Stock and Net Promoter Score System for Inventory and Customer Loyalty

Arya Putra Badruzzaman [1,*], Yudie Irawan [1], Soni Adiyono [1]

[1] Universitas Muria Kudus, Indonesia
[*] Corresponding author: Arya Putra Badruzzaman, Universitas Muria Kudus, Indonesia
✉ aryaputrabz@gmail.com email

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Abstract
Manual and separate inventory management and customer loyalty monitoring often lead to information delays, record-keeping errors, low operational efficiency, and an unmonitored relationship between stock availability and customer perception. The aim of our research was to develop a web-based sales and loyalty information system that integrates Safety Stock and Net Promoter Score (NPS) methods into a single decision support framework. Our research is a study of system development using the Waterfall model, which includes the stages of requirements analysis, system design, implementation, testing, and maintenance, supported by use cases and activity diagrams. The findings of this study are an integrated system that is able to calculate minimum stock levels, safety stocks, risk of stock-outs, and display real-time NPS visualizations. The test results obtained through black box testing on system access, inventory processing, and NPS reporting show that all key functions are running well and to specification. The implications of this study suggest that the proposed system can improve inventory accuracy, reduce the risk of stock shortages, improve operational efficiency, and support objective, responsive, and sustainable managerial decision-making for small and medium-sized distributors through an integrated and reliable information system.

Keywords: customer loyalty; inventory management; net promoter score; safety stock; sales information systems

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INTRODUCTION

Consistent product availability is a key prerequisite for service reliability in the distribution industry, especially amid increasing demand volatility, uncertainty of waiting times, and competitive pressures to maintain high levels of service (Yusuf & Soediantono, 2022). When inventory control systems are unable to systematically anticipate such variability, the risk of stock-outs increases, which not only lowers operational performance, but also has the potential to undermine customer trust and loyalty in the long run (Rada et al., 2025). In the operations management literature, this issue is generally understood as an issue of cost efficiency, service levels, and inventory risk mitigation, while in the marketing literature customer loyalty relationships are seen as the result of the consistency of the service experience and the perception of the company's reliability (Nalatissifa et al., 2023). However, the causal linkages between operational decisions, particularly inventory buffer policies, and the formation of customer loyalty are still rarely explicitly modeled within a single unified analytical framework that explains how demand uncertainty affects safety stock policies, order fulfillment reliability, perception of service quality, and customer loyalty (Anis et al., 2024).

In response to the problem of inventory control and customer loyalty, this study proposes the development of a Decision Support System (DSS) based on a sales and inventory information system that integrates the Safety Stock and Net Promoter Score methods. This approach aims to connect inventory decisions with customer loyalty evaluations in a single data-driven decision-making framework (Anwar & Tanti, 2023). Through the integration of demand data, safety stock calculations, and customer perceptions, the system supports the formulation of inventory policies that are more adaptive to demand uncertainty. In addition to improving the accuracy and consistency of inventory decisions, the DSS developed also plays a role in strengthening service reliability and maintaining product availability in a sustainable manner (Sihotang, 2023). Thus, these solutions not only contribute to operational efficiency, but also support improved service quality and customer loyalty.

The proposed approach is based on the integration of three main theoretical frameworks, namely DSS, Service-Profit Chain, and operation-marketing interface theory. In DSS perspective, safety stock determination is understood as a data-driven decision-making process that transforms demand and lead time information into inventory policy recommendations through modeling and analytical simulations (Khokhar et al., 2023). Service-Profit Chain explains that the stability of internal processes contributes to the improvement of the quality of service perceived by customers, which further forms satisfaction, trust, and loyalty (Hogreve et al., 2022). Meanwhile, the operation–marketing interface theory places product availability as the main link between operational performance and customer evaluation, so that inventory decisions act as a causal mechanism that channels operational performance into the formation of loyalty through service stability (Hu et al., 2023).

A number of previous studies have shown that the Safety Stock method is effective in improving the efficiency of inventory management and reducing the risk of stock shortages (Putri et al., 2024). In addition, the Net Promoter Score (NPS) has proven to be reliable as a quantitative indicator in measuring customer loyalty (Tarigan et al., 2024). Nonetheless, most inventory studies still focus on cost and service level optimization without explicitly linking inventory policy to customer perception as a strategic output (Hasni et al., 2025). Research by Irawan et al. (2023) It shows that the application of a web-based information system with the Safety Stock and Reorder Point methods is able to improve the efficiency of recording and data accuracy, but the approach is still oriented towards internal operational optimization and has not integrated customer satisfaction into the logic of procurement decision-making. This condition is relevant because the management literature still rarely links customer loyalty to tangible operational performance, such as product availability and order fulfillment reliability (Felix et al., 2025).

Conceptually, many studies have not provided a comprehensive theoretical framework to explain the relationship between inventory policy and customer loyalty in an integrated manner (Jehalut, 2023). Analytically, some studies are still limited to a descriptive approach, so the causal relationship between demand variability, safety stock policies, and customer perceptions has not been explored in depth (Sari et al., 2023). In addition, the integration between mathematical models, information system technology, and operational implementation in the field is still not optimal in supporting holistic and system-based decision-making. This condition shows the need for a more structured, comprehensive, and applicative approach to linking inventory control with the formation of customer loyalty.

This study aims to develop a DSS framework that integrates Safety Stock and NPS methods to model the causal relationship between demand variability, safety stock policies, product availability reliability, service quality, and customer loyalty formation. The main contribution of the research lies in the formulation of system-level relationships in a single integrated DSS architecture, which positions inventory buffering decisions not only as an operational risk control instrument, but also as a strategic determinant of customer loyalty. Theoretically, the study expands the integration between the inventory management literature and relationship marketing by offering an integrated causal framework between operational performance and customer perception. In practical terms, the research findings provide a foundation for organizations to improve the reliability of inventory decisions, maintain product availability, and strengthen customer retention strategies through the utilization of operational data and loyalty evaluation.

METHOD

This study applies the SDLC Waterfall system development model which includes the stages of needs analysis, system design, implementation, testing, and maintenance to build a computer Decision Support System. The developed DSS is designed to support structured inventory decision-making by integrating operational data and customer perception evaluation in one unified platform (Asrin & Utami, 2023). The Waterfall model was chosen because it provides a systematic, documented and appropriate development pipeline for systems with clearly defined functional needs.

The unit of analysis comprises two primary data sources: daily product-level sales transactions to assess demand variability and out-of-stock risk, and active customer data to evaluate service quality perceptions using the NPS. The study utilizes 12 months of historical data from 2024, with daily demand and supply records and monthly NPS measurements. These datasets serve as core inputs for the DSS to generate inventory policy recommendations aligned with actual operational conditions.

During the needs analysis phase, the system is designed to process demand data, lead times, and customer feedback to automate safety stock calculations and customer loyalty assessments. Demand data are obtained directly from sales transaction databases, while NPS data are collected through structured surveys of active customers to ensure the validity of service perception measurements.

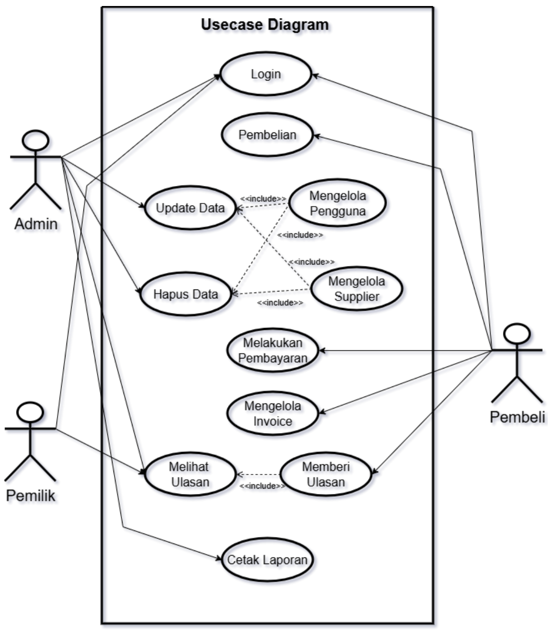

Figure 1. CV Mede kemarik inventory system use case diagram

The system design phase models system actors and functionalities using a Use Case Diagram (Figure 1) to represent inventory data management, safety stock computation, and customer loyalty monitoring. The operational workflow is further illustrated through an Activity Diagram (Figure 2), depicting transaction recording, stock updating, inventory recommendation generation, and structured decision information presentation.

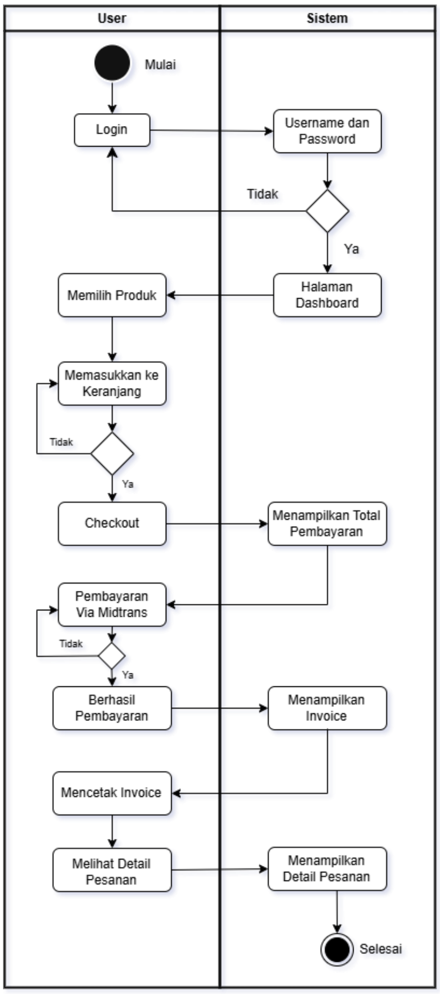

Figure 2. CV Mede kemarik inventory activity diagram

Safety stock calculations are used to anticipate demand uncertainty and variations in waiting times to reduce the risk of running out of stock according to the set service level. This safety stock value is a reference in determining the minimum stock limit as the basis for inventory decision-making. The formulation of the safety stock calculation is presented in equation (1). Meanwhile, NPS is used as an indicator of customer perception of service quality and consistency of product availability. The NPS calculation is shown in equation (2), so that the inventory evaluation takes into account operational and customer loyalty aspects simultaneously (Taufiq et al., 2025).

$$\sigma_L = \mathrm{X} \ \ \sigma_d \sqrt{L} \tag{1}$$

$$\mathrm{NPS} = \%\mathrm{Promotor} - \%\mathrm{Detractor} \tag{2}$$

The testing phase is carried out through functional black-box testing to ensure that all system modules, including safety stock calculations, minimum stock warnings, and NPS visualizations, are running according to specifications. The evaluation of the effectiveness of the system was carried out by comparing conditions before and after implementation based on the frequency of out-of-stock, stability of the service level, and the trend of NPS values. Additional validation is carried out through expert assessments to assess the feasibility and relevance of the decision recommendations generated by the system.

RESULTS AND DISCUSSION

Results

The results of the study show that inventory management at CV Mede Keramik during 2024 has not been fully monitored systematically, especially in determining the minimum stock limit and controlling the risk of inventory shortages. Historical demand and stock data are used to identify annual demand patterns and potential gaps between product demand and availability.

Table 1. Demand and stock of ceramics in 2024

Moon	Ceramic Demand ()m^2	Available Stock ()m^2	Demand–Stock Ratio	Differences (Demand − Stock)
January	2.500	3.000	0,83	-500
February	2.350	2.700	0,87	-350
March	2.900	2.500	1,16	400
April	2.700	2.200	1,23	500
May	2.450	2.000	1,23	450
June	2.800	1.900	1,47	900
July	2.200	1.750	1,26	450
August	2.350	1.600	1,47	750
September	2.950	1.450	2,03	1.500
October	2.500	1.300	1,92	1.200
November	2.300	1.100	2,09	1.200
Opening	2.450	950	2,58	1.500
Quantity	29.450 m^2	22.450 m^2	-	8.000

Table 1 shows that the demand for ceramics at CV Mede Keramik throughout 2024 is volatile with a tendency to increase in the second semester. Critical conditions began to be seen from March to the end of the year, when the demand-stock ratio consistently exceeded one, signaling a stock shortage. The peak of the imbalance occurred in September and November, with ratios of 2.03 and 2.09, respectively, reflecting demand pressure more than doubling on available stock. Cumulatively, total annual demand recorded 29,450 m^2, while stocks were only 22,450 m^2, resulting in an inventory deficit of 8,000 m^2. These findings confirm the need to establish Safety Stock as a buffer mechanism to maintain service sustainability and reduce the risk of stock-outs during periods of high demand.

The results of the Net Promoter Score measurement provide insight into the variation in customer perception of service quality and consistency of product fulfillment during 2024. The actual NPS score is 30, with the proportion of respondents identifying as promoters as much as 50%, passive 30%, and detractors 20%. In the context of demand and stock data, it can be seen that critical stock periods, especially in months with high demand-stock ratios, are associated with lower NPS scores, reflecting customer dissatisfaction with product availability. In contrast, in previous months that recorded more stable stocks, such as January to March, the stock demand ratio was below one, where the NPS score showed a positive trend. Thus, there is a significant relationship between stock conditions and NPS, suggesting that reliability and stock availability directly affect customer satisfaction and loyalty. These findings serve as the basis for planning more effective marketing strategies to retain and increase customer loyalty in the future.

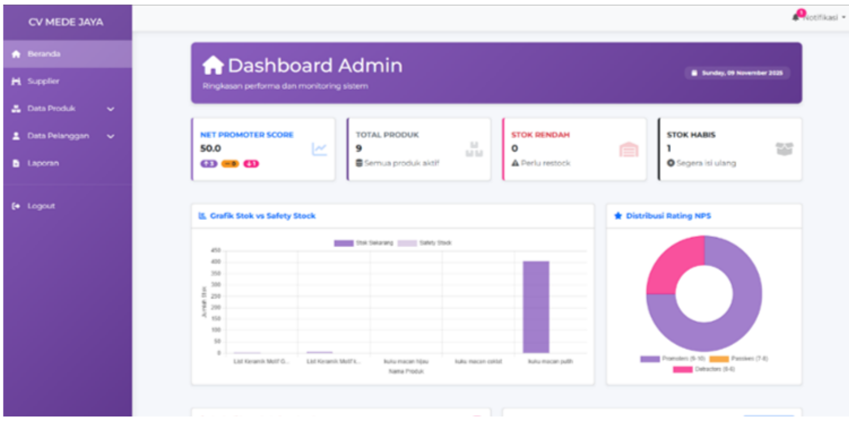

Figure 3. Admin dashboard

Figure 3 shows a comparison between the actual stock and the Safeguard stock limit, which is important for monitoring inventory and detecting potential out-of-stock risks. With this visualization, corrective actions can be taken faster, such as increasing procurement before stock reaches critical limits. For example, when the stock of ceramics drops below 2,000 m², this triggers a notification for resourcing, thus maintaining product availability.

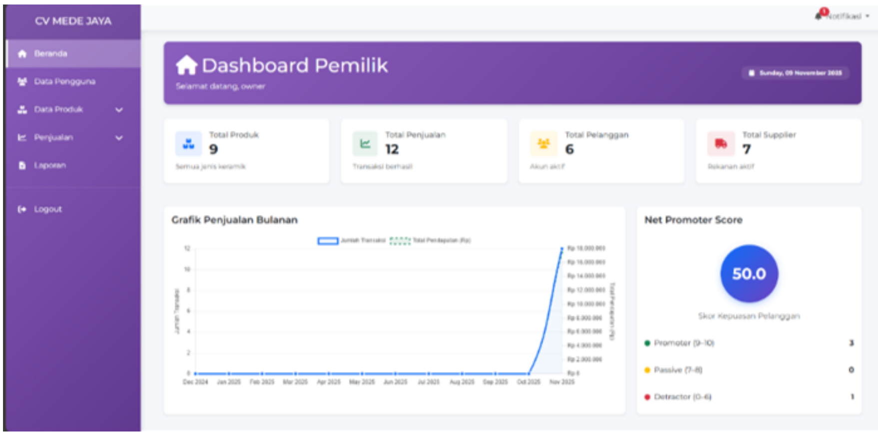

Figure 4. Owner dashboard

Figure 4 presents a summary of sales, inventory conditions, and NPS results, providing an overview of inventory performance and customer perception. An NPS score of 50 indicates that 50% of customers are promoters, 30% passive, and 20% detractors. Data analysis shows that when sales increase, such as in months with total sales reaching 10,000 m², teams can immediately decide to procure additional products before stocks drop below the safe limit, or 2,450 m². This ensures the stability of product availability and supports increased customer loyalty.

The results of black box testing in Table 2 showed that all system functions were running according to the specifications designed. Although this test is technical and not intended as an inferential evaluation, its scientific implications lie in the assurance of the reliability of the system as a prerequisite for the validity of the analysis. Functional reliability ensures that demand data, safety stock calculations, and NPS scores are processed consistently and free from systemic distortions. Thus, system stability not only reflects the successful implementation of information technology, but also becomes a methodological foundation for the quality of decision data and the credibility of the empirical relationship between operational performance and customer loyalty. The functional success of the system is positioned as an essential supporting condition for inventory analysis and loyalty evaluation, rather than as a stand-alone technical contribution.

Table 2. Black box test results

Features tested	Testing Scenarios	Expected Results	Test Results
Goods Data Processing	Add, edit, remove, and search item data	The system stores changes and displays data according to the input	Successful
Customer Data Processing	Add, edit, delete, and search customer data	The system processes changes and displays the data correctly	Successful
Sales Transaction Process	Enter sales transactions and check stock availability	The system calculates totals, validates stock, and stores transactions.	Successful
Safety Stock Calculation	The system runs the safety stock formula according to the demand data and lead time.	Safety stock values are accurately calculated and displayed on the dashboard	Successful
NPS Calculation	The system groups respondents and calculates NPS scores.	The NPS results appear accurate and in accordance with the formula	Successful
Report and Dashboard View	Access reports, charts, and data analytics	Information is displayed accurately and consistently, supporting the quality of decision-making	Successful

Discussion

This research shows that the safety stock policy acts as an operational mechanism that stabilizes product availability amid demand uncertainty. The relationship identified between inventory stability and customer perception is empirically descriptive, so it is not intended to draw causal conclusions inferentially. Nevertheless, the consistency of emerging empirical patterns allows for an analytical explanation of the mechanisms by which operational stability can be translated into the perception of service reliability.

The mechanism works through a process of reducing customer uncertainty. Stable stock availability lowers the risk of transaction failure, such as product delays or unavailability, thereby reducing the cognitive burden on customers in evaluating purchasing decisions. This stability forms a relatively consistent expectation of reliability, where customers judge the company not only based on the quality-of-service interactions, but also on the ability of the operational system to maintain continuity of compliance. In this context, buffering inventory serves as a structural buffer that signals the reliability of the system, which further influences the evaluation of service quality indirectly.

From a relationship marketing perspective, these findings contextualize customer loyalty as the result of the interaction between the relational and structural dimensions. Loyalty is not only built through marketing communications or front-stage interactions, but also through a back-stage operational infrastructure that ensures service promises can be consistently met.

Inventory stability allows companies to maintain alignment between expectations and service realization, which theoretically strengthens customer trust and security. Thus, this study expands on the theoretical assumption that loyalty is a multidimensional construct with a functional and structural foundation that is as important as the emotional aspect.

Compared to previous research, the contribution of this study is conceptually and methodologically differentiative. Previous research generally puts safety stock as an instrument of internal efficiency and operational stability compared to previous research; the contribution of this study is conceptually and methodologically differentiative. Previous research generally puts safety stock as an instrument of internal efficiency and operational stability (Putri et al., 2024). In contrast, studies that validated NPS as a measure of loyalty have not integrated NPS score variation with stock fulfillment performance (Tarigan et al., 2024). Unlike previous research that treated inventory policy and customer loyalty as separate managerial domains, this study positions buffering inventory as an operational antecedent of loyalty perception within an integrated DSS framework. This approach goes beyond the partial model identified by Hasni et al. (2025) and Irawan et al. (2023) by integrating operational decisions and customer evaluations in a single analysis system.

The results also show that the relationship between inventory control and customer loyalty is contextual. The scale of the organization, the level of demand fluctuations, and the complexity of distribution have the potential to moderate the strength of those relationships. In environments with stable demand and simple distribution, stock availability tends to be a major determinant of reliability perception. In contrast, in contexts with high volatility, other factors such as supply flexibility and logistics speed can have a more dominant influence. These findings confirm that inventory stability is a structural supporter of loyalty, not the only determinant.

The limitations of the study, particularly the use of historical data without advanced predictive forecasting and NPS-based loyalty measurements that have not fully captured the non-technical dimension, are positioned as an initial methodological choice that is in line with the exploratory objectives of the study. This limitation opens up opportunities for further research to test causal relationships and enrich the model with mediation and moderation variables.

This research provides three main contributions, namely in the inventory management literature, this study expands the role of safety stock from just an instrument of operational efficiency and stability to a structural support for the formation of the perception of service reliability. Then in the customer loyalty literature, this study contextualizes NPS as an indicator that is not only influenced by the quality of direct service, but also by the performance of the operational system of product fulfillment. And in a cross-domain decision support system study, this study shows that the integration of operational data and customer evaluation in a single unified system framework allows for more holistic decision-making, bridging operations management and relational marketing.

Further research is recommended to develop a more adaptive model by integrating machine learning-based demand forecasting, expanding the industry context and market characteristics studied, and exploring the role of non-operational service variables as mediating or moderation factors. A cross-disciplinary approach that combines operations management, customer behavior analytics, and service strategy is expected to generate a more comprehensive conceptual model and enrich the literature on the system-level relationship between operational decisions and customer relationship value.

CONCLUSION

This study concludes that the integration of Safety Stock and NPS in sales information systems strengthens inventory control while improving understanding of customer loyalty, by showing that inventory buffering plays an indirect determinant of loyalty through service reliability. Scientifically, the study expands the literature by introducing the system-level relationship between inventory management and marketing relationships, as well as filling in gaps in previous research that viewed the two as separate constructs. These findings confirm that operational decisions not only impact internal efficiency, but also have strategic implications for customer perception and the sustainability of business relationships. From a managerial perspective, the results of this study show that the integration of operational data and loyalty evaluation can support more strategic decision-making in maintaining product availability and strengthening customer retention. However, this study is still limited because it has not adopted a predictive demand forecasting model and has not fully captured the non-technical factors that affect loyalty. Further research is suggested to develop a more adaptive analytical approach, expand the industry context, and explore service variables and customer behavior to produce a more comprehensive model.

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