

SUPPLIER SELECTION AT THE RETAIL INDUSTRY USING THE ANALYTICAL HIERARCHY PROCESS (AHP) METHOD (CASE STUDY AT PT. XYZ LOMBOK WAREHOUSE BRANCH)

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ABSTRACT

Introduction/Main Objectives: This study applies the Analytical Hierarchy Process (AHP) to develop a robust supplier selection framework for PT. XYZ's Lombok warehouse to address inventory instability caused by logistical complexities and inconsistent supplier performance.

Background Problems: The core problem is the absence of a standardized supplier evaluation method at the Lombok branch, leading to significant out-of-stock incidents and unfulfilled orders that disrupt regional distribution.

Novelty: The study's novelty is its practical application of a data-integrated AHP model within a regional Indonesian retail network, uniquely incorporating real warehouse performance metrics and geospatial delivery risks.

Research Methods: Using a quantitative, descriptive-analytical design, this research gathered primary data from expert questionnaires and secondary data from company records to build and validate the AHP model.

Findings/Results: The findings identified delivery consistency as the most critical evaluation criterion and produced a clear ranking of the optimal suppliers for cooking oil, UHT milk, and sugar.

Conclusion: The study concludes that the AHP model provides an effective, objective, and data-driven solution to resolve the warehouse's inventory instability by replacing subjective assessments with a transparent decision-making framework.

Implementation Potential: The findings are directly applicable through a developed Microsoft Excel dashboard that automates AHP calculations, enabling managers to continuously improve procurement strategy and enhance supply chain resilience.

Keywords: Supplier Selection; Analytical Hierarchy Process (AHP); Retail Industry; Supply Chain Management; Multi-Criteria Decision-Making (MCDM).

JEL Classification: C44, L81, M11.

1. INTRODUCTION

The retail industry remains a vital driver of Indonesia's economy, maintaining consistent growth over the years (Suriانشa, 2023). In this competitive environment, effective supply chain management has evolved into a core strategic priority (Puspitaningrum, 2024). Logistics serves as the backbone, ensuring smooth coordination of goods from producers to consumers (Cahyaningrum, 2023), where supplier selection becomes the key determinant of operational success. This decision directly influences stability, cost efficiency, product quality, and customer satisfaction (Hayati, 2020). For PT XYZ with over 20,000 outlets and 44 warehouses across Indonesia (Iskandar, 2023) the challenge intensifies in outer regions such as Lombok, which face longer lead times and complex logistics (Fajar et al., 2023). Inaccurate supplier selection can lead to inventory disruption, stockouts, and revenue loss (Fajrah et al., 2025).

This study is driven by operational issues at PT XYZ Lombok, where the absence of a structured supplier performance evaluation system has caused inconsistent outcomes (Agraeni, 2022). To address this gap, the research applies the Analytical Hierarchy Process (AHP) to establish a more objective decision-making model. Theoretically, it enriches existing literature by presenting an AHP-based case study in Indonesia's retail logistics, particularly in non-central regions (Hasiani, 2021). Practically, it provides PT XYZ with a replicable model to improve procurement strategies, build resilient supplier partnerships, and enhance market competitiveness through data-driven, multi-criteria analysis rather than intuition-based judgment.

1.1 Problem Formulation

The core problem at PT. XYZ's Lombok branch is the absence of a standardized and objective supplier evaluation system, leading to 345 Out of Stock (OOS) items and rising Hutang Penerimaan Barang (HPB), which disrupt inventory for 521 stores. This study addresses these

issues by identifying operational constraints, designing supplier evaluation criteria, and applying Thomas L. Saaty's Analytical Hierarchy Process (AHP) to prioritize supplier performance. Since supplier selection is a complex Multi-Criteria Decision-Making (MCDM) process that balances cost and quality (Hasiani, 2021), the research's novelty lies in its practical application of AHP within a regional retail logistics context unlike prior manufacturing-focused studies (Himawan, 2022) to provide data-driven recommendations for more strategic and reliable supplier partnerships.

2. LITERATURE REVIEW

2.1. Supplier evaluation in modern retail supply chains

Recent research highlights that supplier selection and order allocation (SSOA) have evolved from a single cost-based focus to a multi-criteria approach emphasizing quality, delivery reliability, flexibility, sustainability, and risk management amid market volatility (Nguyen et al., 2024). In fast-moving consumer goods (FMCG) and consumer packaged goods (CPG) sectors, where replenishment frequency is high, evaluation accuracy directly affects service levels and store availability; poor evaluations result in Out of Stock (OOS) issues and sales losses. However, much existing research remains manufacturing-centered and fails to reflect the realities of fragmented retail networks with longer and more uncertain lead times. To address this, modern retail supply chains require evaluation frameworks that balance both quantitative and qualitative factors price, quality, service, speed, and trust using integrated models such as the Analytic Hierarchy Process (AHP), which enables comprehensive ranking of suppliers (Sarıçam & Yilmaz, 2021; Hu et al., 2024; Martadisastra & Faisal, 2021; Rana, 2020; Ho et al., 2010; Okwu & Tartibu, 2020).

Beyond operational metrics, successful supplier evaluation must align with relational and strategic dimensions that shape long-term cooperation. Retailers increasingly emphasize trust, communication, and goal alignment with suppliers to ensure mutual performance and reduce risk (Martadisastra & Faisal, 2021; Chuah et al., 2010; Han et al., 2014; Chen et al., 2022). The integration of technology through real-time data sharing, digital inventory systems, and responsive logistics further enhances coordination and market adaptability (Rana, 2020; Yang et al., 2014;

Ebrahim-Khanjari et al., 2012). Simultaneously, sustainable and socially responsible supplier practices are becoming strategic imperatives, addressing regulatory pressures while meeting consumer expectations (Okwu & Tartibu, 2020; Berning & Venter, 2015). Thus, contemporary supplier evaluation in retail represents a complex interplay between performance indicators, relational governance, and sustainability strategies, all of which underpin resilient and competitive supply chains.

2.2. Where AHP stands and its limitations

Within MCDM, AHP remains widely used because it converts qualitative/quantitative criteria into interpretable priorities with consistency checks, making it attractive for retail decision teams. Contemporary frameworks recommend AHP for weight elicitation and hybridization for ranking/robustness (e.g., TOPSIS, ELECTRE, fuzzy/grey extensions) to curb subjectivity and rank-reversal risk (Saputro et al., 2022; Safavi et al., 2025; Salvador et al., 2024). Classic reviews documented AHP's dominance a decade ago; more recent work confirms the trend but urges data-enriched variants and sensitivity analysis to validate rankings under weight drift and scenario shocks (Salvador et al., 2024). In practice, pairwise burdens scale quickly with criteria/alternatives; integrating AHP (for weights) with algorithmic scorers (for rankings) reduces expert fatigue while preserving transparency (Safavi et al., 2025)

2.3. The Research Gap

Taking these threads together, the gap is clear: there is a paucity of AHP-based supplier evaluations that (i) fuse real warehouse-level performance histories, (ii) explicitly operationalize geospatial delivery risk, and (iii) stress-test weights for OOS-sensitive, staple categories within a dispersed retail network. Contemporary reviews call for such data-bound, context-aware hybrids but stop short of implementing them in retail settings with long, variable lead times (Saputro et al., 2022).

3. METHOD

3.1 Research Design

This study employs a quantitative, descriptive–analytical approach to assess supplier performance and its influence on inventory distribution stability in a retail supply chain. Utilizing

the Analytical Hierarchy Process (AHP) within a Multi-Criteria Decision-Making (MCDM) framework, the research structures complex evaluation problems into measurable, comparable dimensions, effectively integrating both qualitative and quantitative factors while maintaining logical consistency (Saaty, 2012). The analysis proceeds through three stages: (1) model construction to identify evaluation criteria and establish a hierarchical framework, (2) data collection based on expert input and warehouse performance indicators, and (3) computation and validation using AHP weighting and consistency tests to rank suppliers. This systematic and auditable design aligns with decision-support best practices in supply chain management (Safavi et al., 2025; Salvador et al., 2024).

3.2 Data Sources

The study utilized a combination of primary and secondary data sources to ensure comprehensive and triangulated results:

1. Primary data were obtained through structured expert questionnaires involving operational managers, procurement staff, and warehouse supervisors at PT XYZ Lombok Branch. Respondents provided pairwise comparisons for AHP analysis across multiple supplier evaluation criteria.
2. Secondary data were derived from company documents, including Purchase Orders (PO), Goods Receipt Notes (GRN), and warehouse stock reports. These data were used to validate consistency and support the quantitative aspects of the evaluation model.
3. The integration of historical performance records with managerial assessments enhances objectivity and mitigates potential biases in subjective judgment (Saputro et al., 2022).

3.3 Sampling Procedures

A purposive sampling technique was applied to select key decision-makers who possess direct experience with supplier interactions and logistics operations. The sample consisted of seven experts, comprising the warehouse manager, procurement officers, and distribution supervisors. This expert group was deemed sufficient to represent the organization's operational and strategic perspectives while maintaining manageable complexity for pairwise comparisons in the AHP model. The sample size conforms to recommendations in prior AHP studies, which emphasize depth of expertise over sample quantity (Fahimnia et al., 2025).

3.4 Analytical Techniques

The Analytical Hierarchy Process (AHP) was employed as the core analytical technique. The analysis followed these steps:

1. Pairwise Comparison Matrix Construction: Experts compared each criterion on a 1–9 Saaty scale to determine relative importance.
2. Weight Derivation: Eigenvector normalization was used to compute criterion weights.
3. Consistency Verification: Consistency Ratio (CR) was calculated to ensure logical coherence (acceptable $CR \leq 0.1$).
4. Supplier Scoring: Each supplier's performance was rated against weighted criteria to compute final priority rankings.

Mathematical processing was performed using Expert Choice 11.5 and cross-checked with Microsoft Excel Solver for eigenvalue validation. This dual verification ensures computational rigor and reproducibility.

4. RESULTS AND DISCUSSION

The initial analysis of PT. XYZ's Lombok branch operations revealed significant inefficiencies in the supply chain, primarily stemming from inconsistent supplier performance. The company's existing method for tracking supplier performance relied on a simple Microsoft Excel dashboard that monitored fulfillment rates against Purchase Orders (POs). However, this system proved inadequate, leading to frequent Out-of-Stock (OOS) situations, particularly for fast-moving consumer goods. The main issues identified at PT. XYZ's Lombok branch include irregular supply from out-of-region suppliers (particularly from Java), which caused delayed deliveries and inventory shortages; the absence of a structured, multi-criteria supplier evaluation framework, resulting in contract decisions based on incomplete performance data and continued reliance on low-performing suppliers; and persistent inventory instability, as historical records revealed consistent failure to meet the 75% supplier service level target, leading to increased *Hutang Penerimaan Barang* (Goods Receipt Debt) and frequent Out of Stock (OOS) incidents for essential products such as sugar, cooking oil, and UHT milk.

Application of the Analytical Hierarchy Process (AHP)

To address these challenges, a supplier evaluation model was developed using the AHP method. The process involved defining a decision hierarchy, establishing evaluation criteria through expert interviews (Warehouse Manager and Merchandiser), and systematically assessing suppliers.

1. Hierarchy and Criteria Development

The decision hierarchy was structured with the primary goal at the top: to select the optimal supplier to stabilize inventory distribution. This goal was supported by four main criteria, which were identified as critical to the company's operational success. Through pairwise comparisons conducted via questionnaires with key personnel, the relative importance (weight) of each criterion was determined. The final weights are summarized below:

Table 1. Summary of Criteria Weights from Pairwise Comparison

Criteria	Weight	Rank
Delivery Consistency	0.37435	1
On-Time Delivery	0.24134	2
Product Quality	0.20768	3
Sales Performance	0.17663	4

The analysis showed that Delivery Consistency is the most critical factor for PT. XYZ, followed by on-time delivery. This underscores the importance of reliability and predictability in the company's supply chain. The consistency of these judgments was validated using the Consistency Ratio (CR), which yielded a value of 0.091, well below the acceptable threshold of 0.10.

2. Evaluation of Alternatives

Each of the four main criteria was further broken down into specific performance levels (alternatives). For example, "On-Time Delivery" was evaluated based on sub-categories such as "On-time," "1–5 days late," and ">5 days late." Pairwise comparisons were also conducted for these alternatives to quantify their priority scores. This process was repeated for all criteria, with consistency checks ensuring the validity of each assessment.

3. Supplier Ranking and Final Results

The final stage involved applying the established AHP model to evaluate suppliers across three key product categories: cooking oil, UHT milk, and sugar. The aggregate score for each supplier was calculated by multiplying their performance rating against each criterion by the corresponding criterion's weight and summing the results. This data-driven approach produced a clear ranking of suppliers for each category. The top-ranked suppliers identified through this evaluation are:

1. Cooking Oil: PT M, with an aggregate score of 0.440.
2. UHT Milk: PT F, with an aggregate score of 0.568.
3. Sugar: PT P, with an aggregate score of 0.458.

The findings confirm that the primary obstacle to stable inventory distribution at PT. XYZ's Lombok branch is the absence of a structured and objective supplier evaluation system. The reliance on inconsistent suppliers, exacerbated by logistical complexities for those located outside the region, has directly contributed to operational disruptions and lost sales opportunities. The application of the AHP method provides a robust solution. By quantifying the importance of key performance criteria, the model shifts the evaluation process from being purely reactive to being strategic and data-driven. The high priority assigned to Delivery Consistency (0.374) reflects the critical need for a reliable and predictable supply flow to prevent stock-outs in a retail environment. The results offer clear, actionable insights for PT. XYZ's management. The supplier rankings for cooking oil, UHT milk, and sugar provide an objective basis for strategic decisions, such as strengthening partnerships with top-performing suppliers and phasing out those who consistently underperform. This approach empowers the company to enhance supply chain resilience, improve product availability, and ultimately maintain its competitive edge.

5. CONCLUSION

The study concludes that the main cause of inventory instability and stock-out events at PT. XYZ's Lombok warehouse is the absence of a structured, multi-dimensional supplier evaluation framework. Reliance on simple order monitoring proved inadequate for managing supply risks, especially with geographically distant suppliers. Using the Analytical Hierarchy

Process (AHP), the research identified Delivery Consistency as the top evaluation criterion, followed by On-Time Delivery, Product Quality, and Sales Performance forming a clear, quantitative priority hierarchy. The model produced objective, data-driven supplier rankings for key categories (cooking oil, UHT milk, and sugar), replacing subjective judgments with transparent decision-making. Moreover, the study developed a practical Excel-based AHP dashboard, enabling PT. XYZ to institutionalize a sustainable, systematic, and user-friendly supplier performance evaluation process.

6. IMPLICATIONS, LIMITATIONS, AND FUTURE RESEARCH

This study offers theoretical and managerial implications for supplier performance evaluation in retail logistics. Theoretically, it enhances the Analytical Hierarchy Process (AHP) by integrating empirical data with expert judgment, improving decision validity and reducing bias. Practically, it provides a structured framework to prioritize suppliers, strengthen transparency, and minimize stockout risks, especially across dispersed networks like Eastern Indonesia. However, its single-branch scope and limited expert input may reduce generalizability, and using standard AHP without hybrid models restricts uncertainty handling. Future research should explore hybrid MCDM approaches (AHP TOPSIS, ELECTRE), incorporate predictive analytics for supplier risk, and add sustainability criteria such as carbon footprint and green logistics performance.

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