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Improving Productivity Through Sustainability-Based Supply Management Packaging in Vitro Diagnostic Device Manufacturing

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Abstract

PT X,Y,Z Biotechnology Indonesia is a medical device manufacturing company still in its pre-operational stage, facing challenges in building an operational system that supports sustainable business growth, particularly in managing packaging material a,b,c,ds. This condition is marked by high minimum order quantities (MOQ) set by several a,b,c,ds, significant lead time variation, and conventional a,b,c,d evaluation that has not yet incorporated sustainability (Environmental, Social, Governance/ESG) aspects. This study aims to develop a sustainability-based packaging a,b,c,d evaluation model to support productivity improvement and procurement efficiency. The study employs a mixed-methods approach on a case study of PT X,Y,Z Biotechnology Indonesia: the qualitative stage was conducted through interviews, Focus Group Discussion (FGD), 5 Why Analysis, and GAP Analysis, while the quantitative stage used historical purchasing transaction data applying the Supply Chain Operations Reference (SCOR) approach combined with the Analytical Hierarchy Process (AHP) to measure and rank a,b,c,ds based on lead time, price, quality, and sustainability criteria. The results show that the average On-Time Delivery (OTD) of the four packaging a,b,c,ds evaluated reached 82.9%, with lead time as the highest-weighted criterion (0.473). The Sustainability-SCOR-AHP model identified PT D and PT C as the a,b,c,ds with the highest composite scores (4.12; preferred a,b,c,ds), while PT B obtained the lowest score (2.17) and is thus recommended to undergo a Corrective Action Plan. This study also formulates two strategies to address MOQ pressure, namely purchase consolidation across packaging variants and volume renegotiation with the top-ranked a,b,c,d. The findings support the achievement of the Sustainable Development Goals (SDGs), particularly SDG 8, SDG 9, and SDG 12.

INTRODUCTION

PT X,Y,Z Biotechnology Indonesia is a medical device manufacturing company focusing on the development and production of diagnostic devices for human medical needs (Aprillia et al., 2026; Kashuri et al., 2025; Sihombing & Nugraha, 2025; ZAIN, 2022). PT X,Y,Z was originally established in 1999 and headquartered in Taiwan, dedicated to the research, development, and manufacturing of innovative medical devices. In 2015, X,Y,Z became part of the Compal Group, and its expansion into Indonesia in 2023 marked an important milestone that broadened its global market reach and created further opportunities for collaboration and growth. Guided by the core values of precision, reliability, and innovation, PT X,Y,Z collaborates with healthcare institutions and professionals worldwide to ensure its products meet market demand and raise healthcare standards. The growth of the glucose monitoring device market is driven by the rising global prevalence of diabetes mellitus; the International Diabetes Federation reported that more than 537 million adults were living with diabetes in 2021, a figure projected to increase to 643 million by 2030, which, together with growing health awareness and government initiatives promoting early diagnosis, continues to strengthen sustained demand for diagnostic test strips as an essential disease-management tool.

This study is conceptually grounded in the Sustainable Development Goals (SDGs) proclaimed by the United Nations (2015), particularly SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), and SDG 12 (Responsible Consumption and Production). Efficient, sustainability-based a,b,c,d management contributes to industrial productivity growth, strengthens innovative healthcare-manufacturing supply chain infrastructure, and promotes more responsible packaging material procurement and consumption practices. Accordingly, PT X,Y,Z Biotechnology Indonesia's effort to develop a sustainability-based packaging a,b,c,d evaluation model is not merely operational but also represents a concrete corporate contribution to these sustainable development agendas.

In recent years, the global manufacturing industry has experienced significant pressure and transformation due to economic dynamics, policy changes, and sustainability demands (Dai et al., 2025; Dwivedi et al., 2023; Hughes et al., 2022; Prabhakar, 2025; Yin et al., 2022). Volatile post-COVID-19 global economic growth has affected global supply chain stability, including raw material scarcity, rising logistics costs, and increasing commodity prices. In Indonesia, the manufacturing sector remains a major contributor to gross domestic product (GDP), driven by rising investment and domestic demand, particularly in the medical device sector; the government has also promoted medical device industry self-reliance through import substitution policies and increased local content requirements (TKDN). In addition, global trends show growing attention to Environmental, Social, and Governance (ESG) principles as a business operations standard, which has become an important factor determining corporate competitiveness, especially in relationships with investors, customers, and business partners.

Sound supply management not only ensures the timely availability of materials and products but also encompasses a,b,c,d performance evaluation, inventory control, planning, and cost efficiency. Previous research in logistics has highlighted the importance of planning and organizational capability in supporting performance. Caroline and Hariadi DP (2021), for example, found that planning had a positive and significant effect on sales support, while team capability had a positive and significant effect on company performance. Similarly, Lumban Gaol and Hariadi DP (2021) demonstrated that project planning significantly influenced technical factors, team capability, and project scope, while these factors subsequently contributed significantly to project performance. These findings indicate that effective planning and organizational capability are important elements in maintaining operational performance, particularly with respect to execution, timeliness, cost, and quality.

Based on the company's initial condition and the need to fulfil customer forecasts, this study identifies that PT X,Y,Z's current a,b,c,d evaluation practice remains conventional and unstandardized, and has not yet integrated sustainability aspects. This condition creates a significant gap in a,b,c,d performance assessment and results in a suboptimal a,b,c,d selection and management process, which is increasingly critical given that the company is still in its pre-operational stage. Packaging plays a strategic role in the medical device industry because it serves as the primary protection for products against contamination and damage while preserving product identity and purity (Kumar, 2023); for in vitro diagnostic devices such as glucose monitoring devices, packaging failure directly affects measurement reliability, patient safety, and regulatory compliance.

This study limits its focus to the management of packaging material a,b,c,ds rather than primary raw material a,b,c,ds, based on three considerations: first, the primary raw material is sourced from a single overseas principal (PT Z), so no comparable alternative a,b,c,d is available; second, the packaging a,b,c,d group shows significant performance and price variation among a,b,c,ds, indicating a real decision space for the company; and third, packaging has a direct impact on final product quality (reject rate), so performance variation among packaging a,b,c,ds carries significant operational risk. Based on 5 Why Analysis and GAP Analysis, three main problem indications were identified: (1) inconsistent lead time from packaging a,b,c,ds, creating uncertainty in material planning; (2) high MOQ preventing the company from purchasing according to actual production needs, thereby increasing inventory burden and working capital requirements; and (3) the absence of a sustainability-based a,b,c,d management model that can serve as an objective guideline for a,b,c,d evaluation and selection.

The uncertainty created by a,b,c,d lead time is particularly relevant to planning because the availability of materials must be aligned with production requirements and purchasing decisions. In this context, previous research has shown that planning is an important component of operational execution. Lumban Gaol and Hariadi DP (2021) found that project planning had significant effects on technical factors, team capability, and project scope, which subsequently influenced project performance. Therefore, in the context of a,b,c,d management, reliable a,b,c,d performance information, particularly lead time, can provide an important basis for more accurate material planning and more consistent operational execution.

Based on the foregoing, the research problems addressed in this study are: (1) how to determine packaging a,b,c,ds capable of meeting the company's lead time requirements; (2) what strategy can address MOQ volume pressure from packaging a,b,c,ds; and (3) how to design a Sustainability-based A,b,c,d Management model that can be implemented to improve the effectiveness of packaging a,b,c,d management at PT X,Y,Z Biotechnology Indonesia. In line with these research problems, this study aims to identify sustainability-based packaging a,b,c,d evaluation criteria covering economic, environmental, and social aspects; analyse a,b,c,d performance based on lead time, price, and reliability indicators; develop a measurable and applicable a,b,c,d evaluation model; and assess the potential impact of the model on reducing lead time, easing MOQ pressure, and stabilising purchase prices.

Compared with established global players, PT X,Y,Z Biotechnology Indonesia remains at the pre-operational stage, though it has already secured two customers that validate initial market acceptance. Its operational scale, however, remains limited and is not yet supported by an optimal a,b,c,d management system: lead time variation among a,b,c,ds and the absence of a performance-based evaluation system indicate a potential risk to supply consistency. The company can therefore be categorised as a niche player at an early market-penetration stage, more accurately positioned as a market follower focused on a specific segment rather than a direct competitor to established brands. Its competitive advantage lies in pricing flexibility and access to products from a global principal that enable accelerated market entry, although it still faces limitations in brand awareness and distribution network. The company's market segmentation focuses on the B2B segment, particularly medical device distributors and local brands requiring competitively priced products, targeting the mass market with mid-range positioning as an alternative to the premium products offered by global players; its strategy is not to compete directly with market leaders but to fill a market gap through cost efficiency and supply chain reliability, for which a structured, sustainability-based a,b,c,d evaluation model is a necessary enabling condition.

Root-cause analysis using the 5 Why technique traced these three problem indications back to a common underlying cause: the company's a,b,c,d evaluation has not been supported by a structured, measurable system, so long lead times, high MOQ, and relatively high purchase prices ultimately stem from suboptimal a,b,c,d management rather than from isolated, unrelated issues. This root cause directly informed the criteria selection for the Sustainability-SCOR-AHP evaluation model developed in this study and applied to the case study in the Results and Discussion section below. The underlying contributing factors include the company's early stage of development, relatively small purchase volume, limited bargaining power vis-à-vis a,b,c,ds, and a still-limited number of a,b,c,d partners, all of which constrain the company's ability to negotiate favourable lead time and MOQ terms until a more structured, evidence-based evaluation and negotiation approach is adopted.

The diagnostic test-strip industry (glucose, uric acid, and cholesterol) is part of the broader healthcare industry that continues to grow alongside rising public awareness of self-monitoring. Applying Porter's Five Forces framework (Porter, 2008) to this industry shows a moderate threat of new entrants, given relatively high entry barriers such as medical device certification, regulatory marketing authorisation, and strict quality standards, although opportunities remain open for players with access to global principal technology and effective distribution partnerships. The threat of substitutes is likewise moderate: continuous glucose monitoring (CGM) technology is emerging as an alternative to routine test strips, but its adoption in developing markets such as Indonesia remains limited due to higher cost and uneven accessibility. Buyer bargaining power is high, particularly in the B2B segment (medical device distributors and institutions), owing to the wide availability of alternative a,b,c,ds and buyers' price sensitivity, whereas a,b,c,d bargaining power is moderate because, despite the need for high-quality raw materials, a reasonably large number of global a,b,c,ds (particularly from China and Taiwan) gives the company room to choose. Competitive rivalry is high, dominated by established global players such as Abbott, Roche, and Ascensia on the strength of brand, technology, and distribution networks, while other players compete on price.

Market-size estimation using a top-down approach based on Indonesia's patient population indicates that the glucose test-strip segment holds the largest potential, with an estimated 7.14 million active monitoring users generating demand of approximately 714 million strips per year and a market size of IDR 2.14-3.93 trillion; the uric-acid segment is estimated at IDR 628-942 billion, and the cholesterol segment at IDR 900 billion-1.2 trillion. Indonesia's continued high dependence on imported products opens opportunities for local companies to enter the market through cost-efficiency and operational-optimisation strategies. Within this landscape, PT X,Y,Z Biotechnology Indonesia can be categorised as a niche player at an early market-penetration stage: the company has already secured two initial customers, validating early market entry in the B2B segment (an estimated 0.1-0.5% of market size), but its operational scale remains limited and is not yet supported by an optimal a,b,c,d management system. This gap between the company's productivity targets and its supply-chain readiness is the central problem this study addresses.

METHOD

This study employed a mixed-methods (qualitative and quantitative) approach with a descriptive-exploratory, applied-research (problem-solving) case study design. The qualitative approach is used to analyse existing conditions and identify problems through PESTEL, Porter's Five Forces, 5 Why Analysis, and GAP Analysis, while the quantitative approach is used in developing a decision-making model using the Supply Chain Operations Reference (SCOR) approach combined with the Analytical Hierarchy Process (AHP) for sustainability-based a,b,c,d evaluation. The case study design was chosen because the research focuses on a single object, PT X,Y,Z Biotechnology Indonesia, to gain an in-depth understanding of the phenomenon within the real context of a company still at the pre-operational stage.

This study uses two data sources: primary and secondary data. Primary data were collected through semi-structured interviews and a Focus Group Discussion (FGD) conducted on 8 June 2026 at PT X,Y,Z Biotechnology Indonesia, involving four key informants representing different but interrelated functions in the procurement decision chain: the Director, Purchasing Supervisor, Quality Assurance Supervisor, and PPIC Supervisor. The FGD aimed to validate and agree on four a,b,c,d evaluation criteria (Price, Quality, Lead Time, and Sustainability) and to obtain expert-judgment pairwise comparisons of the relative importance among these criteria. Secondary data were obtained from the 2025-2026 Purchase Control Database maintained by PT X,Y,Z's Purchasing Division, containing purchasing transaction records including Purchase Order dates, estimated time of arrival (ETA), actual receipt dates, quantities, and unit prices.

Data analysis was conducted in stages in an integrated manner. The qualitative stage used PESTEL and Porter's Five Forces analysis to understand external conditions, followed by 5 Why Analysis and GAP Analysis to identify the root causes of a,b,c,d management problems. The quantitative stage used the SCOR approach to measure a,b,c,d performance on the Reliability (On-Time Delivery Rate), Responsiveness (procurement lead time), and Cost (price coefficient of variation) attributes, which could be measured directly from the Purchase Control Database. Subsequently, the Analytical Hierarchy Process developed by Saaty (1980, 2008) was used to determine the priority weight of each criterion through pairwise comparison and to evaluate a,b,c,d alternatives based on composite scores. Qualitative data validity was achieved through source triangulation, member checking, and FGD, while the reliability of the AHP results was tested through the Consistency Ratio (CR), with the matrix considered consistent when $CR < 0.10$ (Saaty, 2008).

The overall research flow began with identifying the main problem of suboptimal a,b,c,d performance, high lead time, and the lack of integrated sustainability (ESG) aspects affecting company productivity, from which the objective of developing a sustainability-based a,b,c,d management model was formulated. This was followed by external analysis using PESTEL and Porter's Five Forces to understand the business environment and industry structure, then internal analysis and diagnosis through the collection of quantitative data (lead time and price) and qualitative data (via FGD and interviews), which were analysed using GAP Analysis and 5 Why Analysis to identify root causes. Based on these results, strategy evaluation was carried out using the SCOR model to measure supply chain performance and AHP to determine criteria priority in decision-making. The research then formulated a solution in the form of an ESG-based a,b,c,d management model together with an implementation roadmap validated through FGD with relevant stakeholders, producing a sustainability-based a,b,c,d management model expected to improve operational efficiency, supply chain stability, and overall company productivity.

Data were collected through documentation and non-participant observation techniques in addition to interviews. In-depth interviews allow the researcher to obtain a comprehensive understanding of complex phenomena within their real context (Busetto et al., 2020), and are particularly effective for exploring subjective meaning and individual experience (Braun & Clarke, 2021); in this study, interviews were used to identify a,b,c,d management problems, understand the procurement process, and explore factors affecting a,b,c,d performance. Observation provides strong contextual data because the researcher can directly witness phenomena in their natural setting (Moser & Korstjens, 2021) and helps strengthen data validity through empirical evidence (Aspers & Corte, 2019); observation in this study focused on the procurement process, the supply chain flow, and potential sources of operational inefficiency. Document analysis complements the primary data and strengthens validity through triangulation (Bowen, 2009; O'Leary, 2021); in this study, the Purchase Control Database served as the main documentary source for the quantitative SCOR measurement.

Data validity and reliability were tested through an approach adapted to the mixed-methods design. For the qualitative strand, validity was achieved through triangulation of interview, observation, and documentation data (Braun & Clarke, 2021), reinforced by member checking to confirm that the researcher's interpretation matched informants' intent, and by the FGD process which allowed clarification and alignment of perceptions among the parties involved. Reliability in the qualitative strand was maintained through consistency in data collection, recording, and analysis, following a transparent and well-documented procedure (Saunders et al., 2019). For the quantitative strand, AHP validity was achieved through the appropriateness of the hierarchical structure and criteria selection, informed by the literature review and internal discussion, while reliability was tested through the Consistency Ratio (CR), which must be below 0.10 to indicate that expert judgments are logical and defensible (Saaty, 2008).

Table 1. Summary of Focus Group Discussion (FGD) Findings

Informant	Summary of Findings
Director	The company needs a more objective a,b,c,d evaluation system to support decision-making.
Purchasing Supervisor	No structured a,b,c,d evaluation system currently exists.
QA Supervisor	Quality evaluation still relies on incoming inspection results and complaints.
PPIC Supervisor	A,b,c,d lead time frequently changes, complicating production planning.

Source: Interview and FGD results with four key informants at PT X,Y,Z Biotechnology Indonesia, 8 June 2026.

RESULTS AND DISCUSSION

Overview and Identification of A,b,c,d Management Problems

The data used in this analysis is secondary data from the 2025-2026 Purchase Control Database. After data cleaning of blank rows and duplicates, 889 rows of purchasing data were obtained from 248 unique Purchase Order numbers and 85 active a,b,c,ds over the period July 2024 to May 2026, with a total purchase value equivalent to Rp2,685,696,043 (assuming an exchange rate of Rp16,000/USD). The ten a,b,c,ds with the largest purchase value accounted for approximately 93% of total purchase value, with PT Z. (the strip and reagent raw-material principal in Taiwan) as the single largest contributor (68.1%).

Interview and Focus Group Discussion results from the four key informants confirmed the findings of the 5 Why Analysis, namely the suboptimal packaging a,b,c,d evaluation system and high lead time variation. In summary, the Purchasing Supervisor stated that no structured a,b,c,d evaluation system yet exists; the QA Supervisor stated that quality evaluation is still based on incoming inspection results and complaints; the PPIC Supervisor stated that a,b,c,d lead times frequently change, complicating production planning; and the Director stated that the company needs a more objective a,b,c,d evaluation system to support decision-making. These four perspectives formed the basis for establishing the four evaluation criteria (Price, Quality, Lead Time, and Sustainability) used in the subsequent AHP stage.

Table 2. Summary of Purchasing Data (Purchase Control Database 2025-2026)

Description	Value
Number of data rows (purchased items)	889
Number of unique Purchase Order (PO) numbers	248
Number of active a,b,c,ds	85
Data period	July 2024 – May 2026
Total purchase value (equivalent, rate Rp16,000/USD)	Rp2,685,696,043

Source: Data processed from the Purchase Control Database 2025-2026.

Table 3. Ten A,b,c,ds with the Largest Purchase Value

A,b,c,d	Purchase Value (Rp equivalent)	Contribution (%)	Cumulative (%)
PT Z	Rp1,827,912,320	68.06%	68.06%
PT H	Rp319,500,000	11.90%	79.96%
PT I	Rp179,607,000	6.69%	86.64%
PT J	Rp54,340,000	2.02%	88.67%
PT K	Rp35,025,600	1.30%	89.97%
PT L	Rp32,200,000	1.20%	91.17%
PT A	Rp24,490,400	0.91%	92.08%
PT B	Rp24,250,000	0.90%	92.99%

Source: Data processed from the Purchase Control Database 2025-2026.

Table 3 shows that eight of the 85 active a,b,c,ds accounted for approximately 93% of the company's total purchase value, with PT Z. (the Taiwan-based strip and reagent raw-material principal) as the single largest contributor (68.1%). This high concentration of purchases among a small number of a,b,c,ds reinforces the urgency of implementing a structured a,b,c,d evaluation system, particularly for the packaging a,b,c,d group that is the focus of this study's case analysis.

These four problems are elaborated further as follows. Regarding lead time, interview and FGD results confirm that lead time is the primary procurement problem at PT X,Y,Z: variation among a,b,c,ds makes it difficult for the company to determine accurate order timing, and the absence of a structured evaluation system means the company lacks an objective basis for selecting a,b,c,ds with the best lead time performance, increasing the risk of material procurement delays that can disrupt production. Regarding MOQ, several a,b,c,ds apply minimum order quantities that are relatively high compared with the company's actual needs at the pre-operational stage, forcing large-volume purchases that increase inventory value and working-capital requirements and reduce the flexibility of material requirement planning; the company therefore requires an MRP system that considers production needs, inventory levels, and a,b,c,d lead time so that purchasing can be carried out more effectively. Regarding price, observation confirms considerable price variation among packaging a,b,c,ds offering comparable specifications, indicating room for cost-efficiency improvement through more objective a,b,c,d evaluation and data-supported negotiation. Regarding sustainability, GAP analysis and interviews confirm that PT X,Y,Z does not yet have a a,b,c,d evaluation system that considers Environmental, Social, and Governance (ESG) aspects; evaluation still focuses on operational aspects such as price, quality, and lead time without documented sustainability indicators, underscoring the need to integrate ESG into the a,b,c,d evaluation model so that decision-making considers not only operational efficiency but also the sustainability of a,b,c,d relationships.

A,b,c,d Performance Analysis Using the SCOR Approach

A,b,c,d performance was measured quantitatively using three SCOR attributes that could be measured directly from the Purchase Control Database: Reliability, Responsiveness, and Cost. Reliability was measured through the On-Time Delivery Rate (OTD), i.e., the proportion of orders received on or before the ETA. Based on 315 transactions with complete ETA and receipt-date data, the company's overall OTD was 82.9%, with an average deviation of -6.2 days. Responsiveness was measured through procurement lead time (the difference between the goods-receipt date and the PO date); on aggregate, the average lead time was 18.2 days with a median of 12 days, and a coefficient of variation (CV) of 121%, indicating that procurement duration across transactions was highly inconsistent.

Table 4. Reliability and Responsiveness Performance of Selected Packaging A,b,c,ds

A,b,c,d	Item Count	OTD (%)	Average Lead Time	Median Lead Time
PT B	45	30.0%	19.7 days	22 days
PT A	40	61.1%	24.2 days	18 days
PT C	28	100.0%	4.8 days	5 days
PT D	16	100.0%	3.0 days	3 days

Source: Data processed from the Purchase Control Database 2025-2026 (four case-study packaging a,b,c,ds).

Table 4 shows a sharp performance variation among packaging a,b,c,ds. PT D and PT C recorded 100% OTD with average lead times of only 3.0 and 4.8 days respectively, making them the best-performing a,b,c,ds in terms of delivery. In contrast, PT B recorded the lowest OTD (30.0%) despite a relatively large transaction volume, with an average lead time of 19.7 days. For the Cost attribute, an analysis of the price coefficient of variation for inner-box packaging between PT B and PT A across three comparable product categories showed CV ranging from 50.2% to 72.9%, far above the price-variation threshold considered tolerable in sound procurement practice (generally below 10-15%), with PT A prices consistently lower. As a complement, documentation review of the notes column in the Purchase Control Database found an indication of a quality problem (reject) in one PT B transaction, reinforcing the finding of this a,b,c,d's low OTD. Overall, the SCOR measurement results show that PT X,Y,Z's main a,b,c,d problem lies in the responsiveness aspect (lead time variation), followed by price variation and quality issues among several a,b,c,ds.

Table 5. Average Price Comparison of Inner Boxes between PT B and PT A

Product Category (Inner Box)	PT B Price	PT A Price	Coefficient of Variation (CV)
Glucose 25 Strip	Rp12,000	Rp3,200	50.2%
Glucose 50 Strip	Rp17,000	Rp3,260	72.9%
Cholesterol 10 Strip	Rp12,000	Rp2,700	60.3%

Source: Data processed from the Purchase Control Database 2025-2026 (items with comparable description and size).

As a complement to the quantitative Reliability, Responsiveness, and Cost measures, a qualitative review of the notes column in the Purchase Control Database was conducted to examine the Agility and Asset Management Efficiency attributes, for which structured quantitative data (inventory and production-capacity data) were not available. As a supporting indicator of perfect order fulfilment, the match between received quantity and ordered quantity reached 98.9% of all transactions with complete data, indicating that a,b,c,d order-quantity fulfilment is generally sound. Nevertheless, the documentation review identified qualitative notes relevant to a,b,c,d reliability and governance, most notably a recorded partial delivery accompanied by a high reject rate for PT B, reinforcing the finding of this a,b,c,d's low OTD. Although derived from a small number of transactions, this finding provides concrete evidence of the importance of the governance dimension, one pillar of the ESG framework, in PT X,Y,Z's a,b,c,d evaluation and selection process, and underscores the urgency of a structured evaluation model such as the one developed in this study.

A,b,c,d Evaluation and Ranking Using the AHP Method

Based on the SCOR results, which showed significant performance variation within the packaging a,b,c,d group, four a,b,c,ds with active transactions were selected as AHP alternatives: PT B, PT A, PT C, and PT D, evaluated against four criteria: Price, Quality, Lead Time, and Sustainability. Criteria weighting was carried out through a pairwise comparison matrix using the Saaty scale (1-9), based on FGD results with the company's internal team as expert judgment.

Table 6. Pairwise Comparison Matrix of A,b,c,d Evaluation Criteria

Criteria	Price	Quality	Lead Time	Sustainability
Price	1	2	½	4
Quality	½	1	1/3	3
Lead Time	2	3	1	5
Sustainability	¼	1/3	1/5	1

Source: FGD results with the Purchasing, QA, and Production teams of PT X,Y,Z, processed using the Saaty (1980) comparison scale.

Table 7. Criteria Priority Weights and Consistency Test Results

Criteria	Priority Weight	Rank
Lead Time	0.473	1
Price (Cost)	0.284	2
Quality	0.170	3
Sustainability (ESG)	0.073	4

Source: Data processed; $\lambda max = 4.051$; CI = 0.017; RI (n=4) = 0.90; CR = 0.019 (< 0.10, consistent).

The weighting results show a CR of 0.019, well below the 0.10 threshold, so the pairwise comparison matrix is declared consistent. Lead Time obtained the highest weight (0.473), consistent with the finding of high lead time variability (CV 121%) as the most critical problem, followed by Price (0.284). Meanwhile, the Sustainability criterion obtained the lowest weight (0.073), reflecting the company's current condition of not yet having a formal a,b,c,d ESG documentation and measurement system, making this criterion a strategic area for future development rather than one considered unimportant. Each a,b,c,d was then scored on a 1-5 scale for each criterion based on OTD data, price variation, quality non-conformance records, and initial sustainability observations, as presented in Table 8.

Table 8. Alternative Assessment Matrix and Composite Scores of Packaging A,b,c,ds

A,b,c,d	Price (0.284)	Quality (0.170)	Lead Time (0.473)	Sustainability (0.073)	Composite Score	Rank
PT D	3	4	5.00	3	4.12	1
PT C	3	4	5.00	3	4.12	1
PT A	4	4	3.44	3	3.67	3
PT B	2	2	2.20	3	2.17	4

Source: Data processed; composite score $S_i = \Sigma_j (w_j \times x_{ij})$, w_j = criterion weight, x_{ij} = a,b,c,d i score on criterion j.

The composite score results show that PT D and C occupy the highest rank (score 4.12), supported by excellent delivery performance and the absence of quality non-conformance records, and are therefore recommended as preferred a,b,c,ds. PT A ranks third (score 3.67), excelling in price but lagging in lead time. PT B ranks last (score 2.17) due to a combination of the lowest OTD, the longest relative lead time, and a reject record, and is therefore recommended to undergo a Corrective Action Plan (CAP) covering quality improvement, delivery accuracy, and fulfilment of sustainability aspects.

Implications for Material Planning and Business Projection

Beyond the MOQ mitigation strategies above, the a,b,c,d ranking results also support more accurate Material Requirement Planning (MRP): more consistent lead time information allows the company to schedule orders in line with production needs, minimising the risk of stockout and overstock. This finding is consistent with Lumban Gaol and Hariadi DP (2021), who demonstrated that project planning significantly influences technical factors, team capability, and project scope, which subsequently contribute to project performance. In the present study, reliable a,b,c,d lead time information provides a comparable planning foundation by enabling purchasing activities to be aligned with production requirements and supporting more reliable operational execution. Based on realized monthly production and sales data for 2026, a least-squares trend regression yields $Y = 96,428.6 + 395,238.1X$ for strip production and $Y = 4,285.7 + 16,547.6X$ for vial sales, confirming a strong upward trend in the early operational period. Because the month-on-month growth rate slowed over the last three months of observed data (approximately 13.3% for strips and 13.2% for vials), Year 2 and Year 3 projections were adjusted using a decelerating-growth model rather than a pure linear extrapolation, as summarised in Table 8.

Table 9. Year 1-3 Production and Business Value Projection

Indicator	Year 1 (2026)	Year 2 (2027)	Year 3 (2028)
Strip production (units)	15,000,000	≈ 56,300,000	≈ 76,700,000
Vial sales (units)	630,000	≈ 2,284,000	≈ 3,106,000
Business value (IDR)	22 billion	≈ 82.6 billion	≈ 112.4 billion

Source: Processed by the researcher based on internal company data and trend-projection calculations; business value is assumed to grow proportionally with production volume, as per-unit price/margin data were not yet separately available at the time of the study.

The Year 2 and Year 3 projections are estimative and were constructed by extending the growth pattern observed over eight months of actual 2026 data, given the unavailability of maximum production-capacity data or an official company business plan for those years; their accuracy should be re-evaluated using Mean Absolute Deviation (MAD) and Mean Absolute Percentage Error (MAPE) once actual 2027-2028 operational data become available. This projected growth trajectory reinforces the earlier finding that MOQ pressure is expected to ease structurally as order volume approaches or exceeds a,b,c,d-set thresholds, complementing the short-term consolidation and renegotiation strategies discussed above.

MOQ Mitigation Strategies and Model Implications

Unlike the lead time, price, and quality criteria that can be directly addressed through SCOR-AHP ranking, the Minimum Order Quantity (MOQ) constraint is essentially a policy unilaterally set by a,b,c,ds and therefore cannot be resolved through ranking alone. This study formulates two strategies to address MOQ pressure: first, purchase consolidation, i.e., combining purchasing needs across several packaging variants that use the same a,b,c,d into a single ordering cycle so that the a,b,c,d's MOQ threshold can be reached without adding real purchase value beyond production needs; second, volume renegotiation with the top-ranked AHP a,b,c,d, leveraging objective performance data as the basis for the company's bargaining position to obtain a more flexible staged purchasing scheme (call-off order). MOQ pressure on cash flow is also projected to ease naturally as customer order volume grows, so that resolving this constraint is two-layered: a short-term solution through consolidation and renegotiation, and a structural solution through the company's business volume growth.

The proposed strategies also highlight the importance of planning and organizational capability in managing operational constraints. Caroline and Hariadi DP (2021) found that planning had a positive and significant effect on sales support, while team capability had a positive and significant effect on company performance. These findings suggest that planning activities need to be supported by organizational capabilities to translate operational information into effective execution. In the context of PT X,Y,Z Biotechnology Indonesia, purchase consolidation and volume renegotiation require not only a,b,c,d- related decisions but also coordination between Purchasing, PPIC, Production, and Quality Assurance so that purchasing quantities, timing, and a,b,c,d commitments remain aligned with actual operational requirements.

Managerially, this study's findings provide PT X,Y,Z Biotechnology Indonesia with a basis for establishing a more objective and measurable a,b,c,d evaluation system. Management can prioritise price negotiation and long-term contracts with a,b,c,ds that have the largest purchase value, while high-performing a,b,c,ds such as PT D and PT C can be considered preferred a,b,c,ds through increased order-volume allocation and long-term partnership to strengthen supply stability. Conversely, low-performing a,b,c,ds such as PT B should be placed under a Corrective Action Plan (CAP) covering quality improvement, delivery accuracy, and fulfilment of sustainability requirements; if no improvement is observed within the evaluation period, the company may consider reducing purchase allocation or seeking an alternative a,b,c,d as a supply-chain risk-mitigation measure. From a stakeholder perspective, the evaluation and ranking results give a,b,c,ds a clear basis for identifying areas needing improvement, particularly product quality, delivery accuracy, responsiveness, and sustainability compliance, while the Purchasing Division gains a more objective guideline for a,b,c,d selection and periodic evaluation, and the Quality Assurance Division can use the results to monitor a,b,c,d quality conformance and design corrective follow-up actions.

From an operational performance perspective, the findings reinforce the role of planning as a mechanism that connects a,b,c,d information with execution. Lumban Gaol and Hariadi DP (2021) found that project planning significantly influenced technical factors, team capability, and project scope, while these factors had significant effects on project performance. Their findings further indicate that performance is not determined only by the final output but also by the quality of planning and the factors supporting its execution. In the present study, a,b,c,d evaluation provides structured information on lead time, price, quality, and sustainability that can be incorporated into purchasing and material planning decisions. Therefore, the Sustainability-SCOR-AHP model extends the planning-performance perspective into a,b,c,d management by providing a measurable basis for a,b,c,d selection, allocation, and corrective action.

Theoretically, these findings support previous research on the importance of planning and organisational capability in achieving performance while extending its application to a,b,c,d management in the medical device manufacturing context. Caroline and Hariadi DP (2021) demonstrated the relevance of planning, sales support, and team capability in logistics company performance, while Lumban Gaol and Hariadi DP (2021) showed that project planning influences factors that subsequently contribute to project performance. The present study extends this perspective by integrating a,b,c,d performance measurement with planning-oriented decision making through the SCOR-AHP framework. In addition, the findings support Govindan et al. (2021), who argue that sustainability aspects need to be integrated into a,b,c,d evaluation, and reinforce the application of the AHP method (Saaty, 1980) as an effective approach for weighting decision-making criteria, while showing that the SCOR framework can be adapted as a basis for a,b,c,d evaluation in the pre-operational medical device manufacturing industry. This study has several limitations, including limited sustainability (ESG) data that is not yet formally documented, incomplete ETA data for some transactions, a case-study scope limited to four packaging a,b,c,ds out of 85 active a,b,c,ds so that generalisation to all a,b,c,d categories requires further replication, a research period (April-August 2026) that precedes the company's full operational stage (May 2026) so that the quantitative impact of the model on lead time reduction and cost efficiency could not yet be measured empirically, and subjectivity in AHP weighting arising from FGD with a limited number of internal informants.

Three-Year Implementation Roadmap

As a synthesis of the overall analysis, this study proposes a cyclical Sustainability-SCOR-AHP a,b,c,d evaluation model comprising five stages: (1) data collection, i.e., periodic consolidation of purchasing transaction data to obtain up-to-date a,b,c,d performance data on lead time, OTD, and price; (2) criteria weighting (AHP), through periodic FGDs with the Purchasing, QA, and Production teams to review criteria weights and maintain a consistent CR (< 0.10); (3) performance measurement (SCOR), calculating OTD, lead time, and price variation per a,b,c,d; (4) ranking and follow-up, calculating composite scores and preparing action plans such as renegotiation, corrective action, or a,b,c,d diversification; and (5) ESG monitoring, developing and distributing a structured a,b,c,d ESG questionnaire to replace the current baseline estimation with validated scores. Because this model is cyclical rather than a one-off assessment, it allows PT X,Y,Z to conduct continuous a,b,c,d evaluation in line with the continuous-improvement principle of supply chain management.

Implementation is planned in stages over three years, aligned with the company's transition from the pre-operational stage to full operation, so that the company has sufficient time to adjust business processes, improve data quality, and evaluate the model's effectiveness in raising productivity. In Year 1 (2026), against a forecast target of 15 million strips, 630 thousand vials, and IDR 22 billion in business value, the focus is on foundation and piloting: applying the SCOR-AHP model to the packaging-a,b,c,d case study, establishing a periodic a,b,c,d-evaluation SOP, improving ETA data completeness, and designing the a,b,c,d ESG questionnaire instrument. In Year 2 (2027), with a projected target of approximately 56.3 million strips, 2.28 million vials, and IDR 82.6 billion, the focus shifts to expansion and digitalisation: extending the model to raw-material and service a,b,c,d categories, integrating SCOR-AHP results into the ERP/procurement system, executing Corrective Action Plans, and reviewing AHP criteria weights quarterly. In Year 3 (2028), with a projected target of approximately 76.7 million strips, 3.11 million vials, and IDR 112.4 billion, the focus is on optimisation and continuous improvement: evaluating the model's impact on cost efficiency, lead time, and productivity, refining AHP weights based on historical data, exploring Fuzzy-AHP, and conducting ESG audits/certification of key a,b,c,ds. This roadmap is indicative and sequential, as first-year success in data foundation and SOP establishment is a precondition for second-year model expansion and third-year quantitative impact validation, with implementation pace adjusted to PT X,Y,Z's transition from pre-operational to full operational status.

Beyond the immediate case study, these findings carry broader relevance for Indonesia's medical device manufacturing sector, which the government continues to encourage toward greater self-reliance through import-substitution policies and higher local content requirements (TKDN). As more domestic manufacturers move through a similar pre-operational-to-operational transition, a replicable, data-driven a,b,c,d evaluation approach such as the Sustainability-SCOR-AHP model offers a practical pathway for building supply chain resilience and ESG readiness from an early stage, rather than retrofitting sustainability considerations after operations have scaled. In this sense, the model developed here contributes not only to PT X,Y,Z's internal procurement practice but also to the broader discourse on strengthening sustainable, innovation-driven supply chain infrastructure in Indonesia's healthcare manufacturing industry, consistent with the SDG 9 agenda discussed in the literature review.

CONCLUSION

This study developed a Sustainability-SCOR-AHP-based packaging a,b,c,d evaluation model at PT X,Y,Z Biotechnology Indonesia, an in vitro diagnostic device manufacturer still at the pre-operational stage. The results show that the average On-Time Delivery of the four-packaging a,b,c,ds evaluated reached 82.9%, with lead time as the highest-weighted criterion (0.473) in a,b,c,d selection decisions, followed by price (0.284), quality (0.170), and sustainability (0.073). The model successfully identified PT D and PT C as the a,b,c,ds with the highest composite scores (4.12), recommended as preferred a,b,c,ds, while PT B obtained the lowest score (2.17) due to a history of quality non-conformance and delivery delay, and is therefore recommended to undergo a Corrective Action Plan. This study also formulated two strategies to address minimum order quantity pressure, namely purchase consolidation across packaging variants and volume renegotiation with the top-ranked a,b,c,d. Based on these findings, PT X,Y,Z Biotechnology Indonesia is advised to apply the Sustainability-SCOR-AHP evaluation model periodically (e.g., quarterly) to all a,b,c,ds with the largest purchase value contribution, develop Material Requirement Planning that integrates demand data and a,b,c,d lead time, build a formal a,b,c,d sustainability assessment system, and carry out continuous a,b,c,d development programmes for low-performing a,b,c,ds. For future research, it is recommended to extend the model's application to all a,b,c,d categories, conduct longitudinal evaluation to measure the model's actual impact on cost efficiency and productivity once the company is fully operational, involve a larger and more diverse group of expert-judgment respondents in the AHP process, and develop a standardised, verified a,b,c,d ESG measurement instrument.

REFERENCES

Aprillia, C., Zahra, A. A., Malau, J., Ainaputri, A. S., Siboro, D. P. P., Apriyanti, E., & Nugraha, A. T. (2026). Biotechnological Advances in Tuberculosis Diagnosis: Global Developments and Their Applicability in Indonesia. *Journal of Pharmaceutical and Sciences*, 423–445.

Alsaleh, A. (2025). Toward a conceptual model to improve the user experience of a sustainable and secure intelligent transport system. *Acta Psychologica, 255*, 104892.

Ayo, S. C., Ngala, B., & Amzat, O. (2018). *Information security risks assessment: A case study*.

Burger, G., & Guna, J. (2024). Enhancing driving safety through user experience evaluation of the C-ITS mobile application: A case study of the Dars Traffic Plus app in a driving simulator environment. *Sensors, 24*(15), 4948.

Dimian, M., Zadobrischi, E., Căilean, A., Beguni, C., Avătămăniței, S.-A., & Paşcu, P. (2024). Digital transformation of the transport sector towards smart and sustainable mobility. In *Digital transformation: Technology, tools, and studies* (pp. 215–237). Springer.

Fatorachian, H., Kazemi, H., & Pawar, K. (2025). Digital transformation for sustainable transportation: Leveraging Industry 4.0 technologies to optimize efficiency and reduce emissions. *Future Transportation, 5*(2), 34.

Grigaliūnas, Š., Schmidt, M., Brūzgienė, R., Smyrli, P., Andreou, S., & Lopata, A. (2024). Holistic information security management and compliance framework. *Electronics, 13*(19), 3955.

Herath, T. C., Herath, H. S. B., & Cullum, D. (2023). An information security performance measurement tool for senior managers: Balanced scorecard integration for security governance and control frameworks. *Information Systems Frontiers, 25*(2), 681–721.

Hidayatullah, D. E. R., Kunthi, R., & Harwahyu, R. (2024). Design and analysis of information security risk management based on ISO 27005: Case study on Audit Management System (AMS) XYZ Internal Audit Department. *International Journal of Electrical, Computer, and Biomedical Engineering, 2*(3). https://doi.org/10.62146/ijecbe.v2i3.81

Huang, Y., Hu, M., Xu, J., & Jin, Z. (2023). Digital transformation and carbon intensity reduction in transportation industry: Empirical evidence from a global perspective. *Journal of Environmental Management, 344*, 118541.

International Organization for Standardization. (2022). *ISO/IEC 27005:2022 information security, cybersecurity and privacy protection—Guidance on managing information security risks*.

International Standard Organization. (2022a). *ISO/IEC 27001:2022 information security, cybersecurity and privacy protection—Information security management systems—Requirements*.

International Standard Organization. (2022b). *ISO/IEC 27002:2022 information security, cybersecurity and privacy protection—Information security controls*.

Irfan, M. N., Ramadhania, S., Hadi, S., & Pungkasanti, P. T. (2025). ISO/IEC 27005-based e-learning risk management with blockchain architecture: A case study of Semarang University. *Journal of Information Systems and Informatics, 7*(3), 2898–2919. https://doi.org/10.51519/journalisi.v7i3.1265

Islam, M. D. (2025). *Web-based real-time bus tracking system for enhanced commuter experience and efficient fleet management*.

Kure, H. I., Islam, S., & Mouratidis, H. (2022). An integrated cyber security risk management framework and risk prediction for the critical infrastructure protection. *Neural Computing and Applications, 34*(18), 15241–15271.

Li, P., Xue, R., Shao, S., Zhu, Y., & Liu, Y. (2023). Current state and predicted technological trends in global railway intelligent digital transformation. *Railway Sciences, 2*(4), 397–412.

Mujib, M. S. (2021). *Penilaian risiko keamanan informasi pada sistem informasi manajemen rumah sakit menggunakan kerangka kerja ISO/IEC 27005:2022*.

Muralidharan, V. (2025). The IoT-based toll gate management system. *ICNGTS*.

Nazari, Z., & Musilek, P. (2023). Impact of digital transformation on the energy sector: A review. *Algorithms, 16*(4), 211.

Safitra, M. F., Lubis, M., & Fakhrurroja, H. (2023). Counterattacking cyber threats: A framework for the future of cybersecurity. *Sustainability, 15*(18), 13369.

Sharma, M., & P. C., A. (2013). A research survey: RFID security & privacy issue. *Computer Science & Information Technology*, 255–261. https://doi.org/10.5121/csit.2013.3526

Taherdoost, H. (2022). Understanding cybersecurity frameworks and information security standards—A review and comprehensive overview. *Electronics, 11*(14), 2181.

Verma, S. K., Verma, R., Singh, B. K., & Sinha, R. S. (2024). Management of intelligent transportation systems and advanced technology. In *Intelligent transportation system and advanced technology* (pp. 159–175). Springer.