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Optimizing Vendor Selection and Standardization in EDC Machine Supply Chain

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Abstract: The main problems faced by the organization are undelivered SLA performance, non-standard quality between vendors in different areas nationally, and no standard in outsourcing of certain selected vendors. This study aims to optimize the vendor selection and standardization process in the EDC machine supply chain process at PT. XYZ, by utilizing the IT Governance approach using COBIT 2019. By using a research methodology with qualitative and quantitative approaches, this study analyzes the gap between Vendor Governance by utilizing the main domains of COBIT 2019, especially in APO10 (Managed Vendors), DSS01 (Managed Operations), and MEA01 (Monitoring Performance). This process includes mapping Enterprise Goal to Alignment Goal and selecting the relevance domain to be used, and measuring the process Capability Level using Level 0-5. The results of the study show that more of several key activities in the APO10, DSS01 and MEA01 domains are still at capability levels 2 and 3, indicating that some activities are not well documented consistently in some areas. Therefore, the novelty of this research is conveyed by making a performance assessment based on Simple Weighted Average (SAW) as part of the Multi Criteria Decision Making (MCDM) model, performance scorecard, vendor evaluation and vendor rationalization simulation to enforce efficiency and improve service quality.

Keywords: Capability maturity model; COBIT 2019; IT governance; MCDM

Introduction

According to Rawat et al. (2023) recent trends such as on-demand and same-day delivery, along with the growing emphasis on personalized customer experiences, are reshaping how goods and services are transported and distributed. These developments reflect a broader shift in service delivery models, where speed, flexibility, and customer-centric approaches have become essential benchmarks. Organizations across industries are being pushed to adapt quickly, as failing to meet these rising expectations risks losing competitiveness in today's fast-changing market environment.

To respond to these demands, many companies have adopted outsourcing as a way to expand their capacity and manage operational complexity more effectively. PT. XYZ follows a similar path, depending on third-party vendors to support critical aspects of its service delivery (Zhu et al., 2022). Outsourcing allows the company to scale resources, gain access to specialized expertise, and maintain efficiency without the need for heavy investment in infrastructure and manpower. At the same time, however, it introduces challenges related to governance, oversight, and accountability that require careful management.

As highlighted by Bolívar & Meijer (2016), vendors play a decisive role in determining the success of outsourced services. While vendors are responsible for executing much of the operational workload, the ultimate accountability for ensuring alignment with strategic objectives remains with the sponsoring

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organization. This makes effective vendor management a key factor in sustaining service quality. For PT. XYZ, whose operations extend across diverse regions in Indonesia, strengthening governance of outsourced vendors is not merely an operational requirement but also a strategic priority to ensure consistent service standards in a competitive industry landscape (Li, 2022).

Performance evaluation has become increasingly important in this regard. As noted by Yin & Song (2023), measuring performance in logistics and service delivery is essential to ensure that operational goals are met and that customers receive the level of service they expect. In banking and financial services, this is particularly critical because trust and reliability are directly linked to service performance (Tomor et al., 2019). points out that Service Level Agreements (SLAs) are a central mechanism for managing the financial and operational risks of outsourcing arrangements. Failure to meet agreed service levels, or weak handling of service disruptions, can erode trust between institutions and their customers. For large banks managing hundreds of thousands of EDC units nationwide, service delivery performance is not just an operational metric but a cornerstone of customer confidence and the broader reliability of the cashless payments ecosystem (Veena et al., 2024).

Within this context, vendor management at PT. XYZ takes on a pivotal role, as the majority of EDC deployment, maintenance, and replacement activities are handled by third-party providers under SLA monitoring (Salunke, 2024). An SLA is not merely a contractual formality but a governance instrument that establishes clear performance metrics and consequences for non-compliance (Haritiantari et al., 2024). As described by Khotimah et al. (2022), an SLA essentially defines the minimum standards expected during the contract period and the penalties or corrective actions if those standards are not met (Maulana, 2024).

Ensuring the consistent achievement of SLA targets has therefore become a top priority for PT. XYZ. For example, in the case of EDC deployment (new installation or PB – Pemasangan Baru), the agreed SLA requires delivery within one business day from the request, with a 99% fulfillment target. For maintenance services—covering inspection, repair, and replacement the SLA stipulates a response time ranging from 4 hours after incident reporting to a maximum of 2 days, depending on the location, again with a 99% compliance target (Santoso et al., 2020).

Table 1. SLA target of PT. XYZ in managing onboarding & maintenance services

Scope of Service	Service Quality	SLA Target %
Onboarding/PB	Day +1	99
Maintenance	Hour +4 to 2 days (area dependency)	99

In practice, however, the performance outcomes have not met expectations. Based on PT. XYZ's 2024 performance reports, SLA achievement for deployment in the Jabo area (Jakarta, Bogor, Depok, Tangerang, Bekasi) reached the 99% target only once, in February, while outside Jabodetabek the target was met in 9 out of 12 months (Kassim et al., 2019). Maintenance performance showed even greater variability: in non-Jabodetabek regions, SLA compliance was achieved only twice throughout the year, and in Jabodetabek, maintenance services struggled particularly in the first three quarters of 2024, with monthly averages around 95% and the lowest performance dropping to 91% in February, as presented in Figure 1.

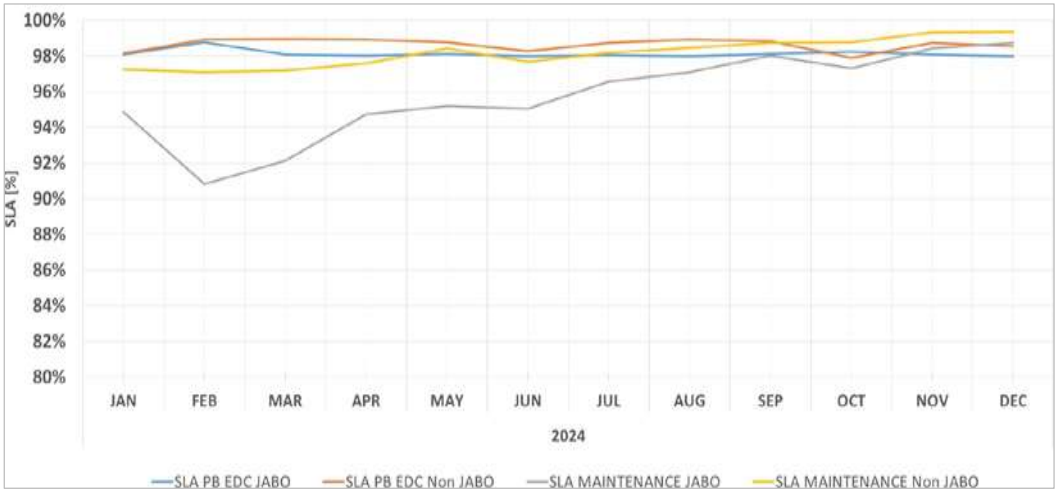

Figure 1. SLA performance of PT. XYZ 2024

These persistent SLA shortfalls represent a significant issue for PT. XYZ. The inability to consistently meet agreed service levels undermines both operational reliability and customer confidence (Tarannum & Zghair, 2024). Given the scale of outsourced vendor involvement in the EDC supply chain, this study is therefore undertaken to analyze and develop approaches for optimizing vendor selection and standardization in order to strengthen service delivery performance and support PT. XYZ's long-term operational excellence (Furkan et al., 2021).

Although outsourcing has become a strategic approach for PT. XYZ in managing the deployment and maintenance of EDC machines, the company continues to encounter persistent difficulties in meeting the agreed Service Level Agreements (SLAs) (Cichosz et al., 2020). Designed to ensure service consistency, accountability, and reliability, SLAs have not been consistently achieved in practice (Khoo, 2022). Performance reports in 2024 revealed recurring gaps, where deployment targets in Jabodetabek only reached the 99 (Purwanto et al., 2021).

These repeated failures to achieve SLA targets not only disrupt operational reliability but also erode customer confidence and threaten PT. XYZ's ability to uphold trust in the broader cashless payment ecosystem (Ariyanti et al., 2021). The discrepancy between SLA commitments and actual outcomes indicates that the issue cannot be attributed solely to operational lapses, but instead reflects underlying challenges related to vendor capability, governance oversight, standardization, and process efficiency (Huang et al., 2019).

In light of these findings, the central research problem in this study is identified as the undelivered SLA performance in outsourced vendor services for EDC deployment and maintenance at PT. XYZ. To gain a deeper understanding, this problem will be examined through a fishbone analysis which categorizes potential root causes across five dimensions: man, method, material, environment, and process (Saleem et al., 2022). This structured approach provides a foundation for developing a framework to optimize vendor selection and standardization in PT. XYZ's supply chain.

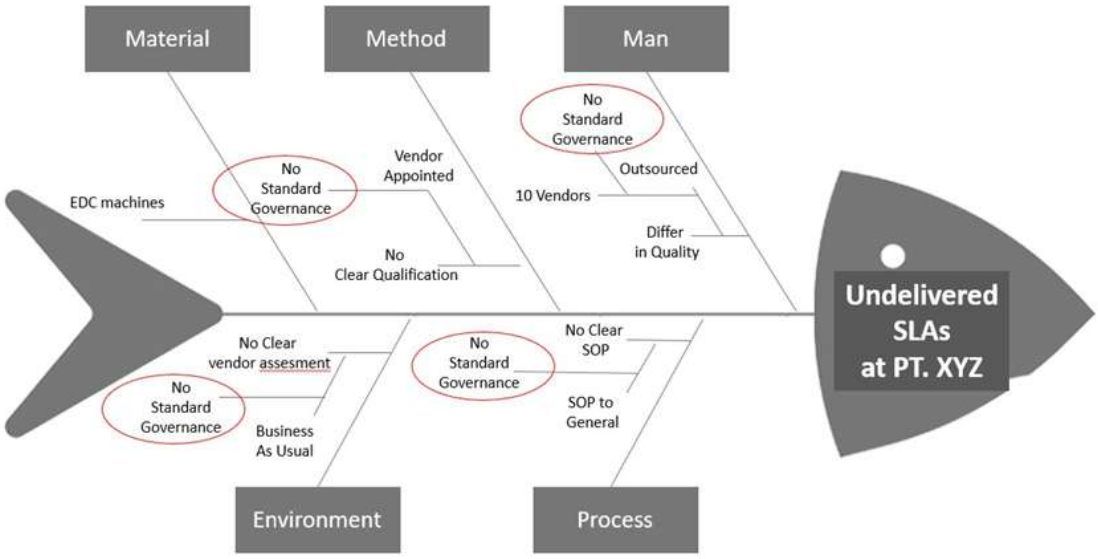

Figure 2. Fish Bone Diagram

After analyzing the fishbone diagram, the primary root cause of undelivered SLAs at PT. XYZ is identified as the absence of standardized vendor governance (Velly et al., 2022). This gap results in inconsistent vendor quality, unclear qualification processes, inadequate SOPs, and ineffective performance monitoring. In turn, these weaknesses undermine the ability of PT. XYZ to ensure SLA compliance in EDC deployment and maintenance (Sinaga & Rajagukguk, 2022). Addressing this governance deficiency therefore becomes the central focus of this research, guiding the development of a framework for optimizing vendor selection and standardization in PT. XYZ's supply chain (Pestronk et al., 2021).

Method

Methodological Bridge: From Literature to Design

Chapter 2 established a governance-first foundation for solving the SLA shortfalls in vendor-managed EDC services. Based on explicit criteria (governance coverage, operational enactment, performance/conformance, and

accessibility), this study adopts COBIT 2019 and narrows scope to three objectives that match the problem structure: APO10 (Managed Vendors), DSS01 (Managed Operations), and MEA01 (Managed Performance and Conformance) (Rainy & Chowdhury, 2022). These objectives respectively formalize vendor qualification and oversight, translate governance into timestamped SOPs, and enforce KPI review with corrective actions (Ahmad et al., 2024).

The study follows three design principles that guide all methods and artefacts: Governance-first (APO10): rules, criteria, SLA annexes, and review cadence are defined before optimization. Evidence-led (MEA01): KPI catalogues, thresholds and dashboards bind decisions to auditable data. Operational discipline (DSS01): intake, dispatch, field work, verification, and closure are standardized and time-bound (e.g., H+4–D+2).

Respondents and instruments. Capability is measured with a role-based questionnaire derived from activity statements in APO10, DSS01, and MEA01. Ratings use the COBIT 0–5 capability scale and must cite artefact evidence (Soegoto et al., 2022). The SVP and VP rate all three objectives; the three AVPs rate APO10 and MEA01 only. Decision scope. Vendor rationalization reduces incumbents from 10 to 5. The subsequent tender evaluates 12 candidates (10 existing + 2 entrants) under the same scoring architecture; entrants apply a provisional-history policy to ensure fairness (Doymus et al., 2022). Data and scoring. Historical SLA/ticket logs, warning-letter counts, pricing mechanism and TCO, plus questionnaire sub-criteria feed a Simple Weighted Average (SWA) composite with prioritization floors, sensitivity checks, and fairness adjustments. SWA is used because weights are explicit and auditable (Mat Kasim and Goh Abdullah, The remainder of this chapter operationalizes these choices step by step (Boone et al., 2025).

Proposed Framework Overview

The proposed governance–operations–evaluation framework is illustrated in Figure 3.1 summarises the governance–operations design implemented in this research. COBIT 2019 provides the spine (EG08→AG05 alignment to APO10, DSS01, MEA01). The current condition and the capability assessment inform focused FGD and design, which yield a staged roadmap, an SWA-based vendor scoring on historical data, and baseline SOPs. Validation covers instrument/face/content checks; Evaluation reports the quantitative and qualitative results in Chapter 4. The subsequent sections implement Figure 3.1: data and respondents capability assessment (3.4), SWA vendor scoring (3.5), SOP baselines (3.6), roadmap construction (3.7), and the validation & evaluation plan (3.8).

Data Sources and Respondents

Data for this study comprise: 2024 SLA/ticketing logs for Install, Init, Maintenance, and QRIS (with H+4–D+2 timestamps); warning-letter counts; pricing mechanism evidence and total cost of ownership (TCO) basket; questionnaire sub-scores (Legal & Finance, Operational Mechanism, Technical Capability, Workforce Quality, Transaction Risk); capability ratings for APO10, DSS01, MEA01 with artefact references; and interview/FGD notes used to elicit weight rationales and improvement priorities. Respondent roles follow the instrument design in Chapter 2: the SVP and VP (CIO roles) rate APO10, DSS01, MEA01; three AVPs (Heads of Development) rate APO10, MEA01 only, assignment as shown. All capability ratings use the COBIT 0–5 scale with required evidence (policy/contract extracts, SOP pages, dashboards/logs, review minutes). The respondent role distribution across domains is shown in Table (Wachyudi et al., 2020).

Capability Assessment Procedure (APO10, DSS01, MEA01)

The assessment proceeds in four stages: S1 briefing (scale definitions, evidence types); S2 independent rating by assigned domains; S3 collection/screening (return once if evidence or notes are incomplete); S4 consensus mini-FGD for items with high dispersion. Item ratings are aggregated by median; items with a spread > 1 scale point between any two raters are flagged for S4. For each item, compute the median and IQR; for each domain, take the median of item medians as the domain capability and report domain IQR. Inter-rater agreement is documented using Kendall's W per domain; where $W < 0.5$ after S4, medians are retained with a note that roadmap targets will be set conservatively (Oguche, 2018).

SWA Vendor Scoring Method

The scoring architecture follows Chapter 2: four blocks with global weights that sum to 1.0—History (0.30), Pricing (0.30), Questionnaire (0.35), Bonus (0.05). Indicators are normalised to [0, 1]: SLA buckets and warning-letter mapping for History; transparency and mechanism score plus TCO for Pricing; five sub-criteria (Legal, Operational, Technical, Workforce, Risk) for Questionnaire; binary for Bonus. New vendors without internal history receive a provisional history (0.20 attestations, 0.10 pilot/reference test; missing portions scored zero) (Chidozie et al., 2024). One entrant (Vendor K) qualifies as a Recognized Subcontractor; its History (0.30) is computed from PT. XYZ tickets attributable to its executed work under a former prime vendor, using the same bucket rules and warning-letter mapping as incumbents (Martinez-Valencia et al., 2021).

Prioritization Model

Improvement items are prioritized by Gap Severity (distance from target on the 0–5 capability scale), Business Impact (contribution to SLA outcomes), and Feasibility (resources/lead time), scored 1–5 each. The priority index represented by Formula 1.

$$P = a\,\text{Severity} + \beta\,\text{Impact} + \gamma\,\text{Feasibility} \quad (1)$$

with (a, β, γ) agreed in the FGD (default 0.4, 0.4, 0.2). Items are then scheduled into Waves 1–3 with owners, dependencies, and MEA01 thresholds.

Results and Discussion

Capability Assessment Results (APO10, DSS01, MEA01)

This section reports the baseline capability levels for the three selected COBIT 2019 objectives—APO10 (Managed Vendors), DSS01 (Managed Operations) and MEA01 (Performance and Conformance)—using the procedure defined in Chapter 3. Ratings were collected by domain-assigned roles, aggregated by the median, and summarised with the interquartile range (IQR) (Jafari-Sadeghi et al., 2021). Items with high dispersion (spread > 1 scale point between any two raters) were discussed in a short consensus session, after which final medians were confirmed. A compact visual summary of the domain medians against the target levels is provided in Appendix Item-level distributions and domain summaries (Barrane et al., 2021).

Table presents item-level results for each domain on the COBIT 0–5 scale.1 Items flagged with (Δ) exhibited dispersion > 1 and underwent consensus clarification before finalising medians. For each domain, the domain capability is the median of item medians, reported with its IQR. 1Scale anchors follow COBIT 2019 capability guidance. Evidence references (policy extracts, SOP pages, ticket logs, review minutes) are recorded per item (Kaul & Khurana, 2022).

Table 2. Domain-by-item capability medians (0–5) and dispersion

Domain	Item (short label + COBIT codes)	Median	IQR	Flag	Primary evidence
APO10	Vendor qualification & due diligence [APO10.01–.02]				Contract/SOW; checklist
APO10	SLA structure & penalty clauses [APO10.03, APO10.05]				SLA annex; KPI list
APO10	Relationship oversight & reviews [APO10.03]				Minutes; scorecards
APO10	Risk & dispute resolution [APO10.04, APO10.03]				Risk log; escalation records
DSS01	Intake, triage & dispatch discipline [DSS01.01–.02]				Ticket timestamps
DSS01	On-site work & first-time fix [DSS01.01–.02]				WO forms; photos
DSS01	Verification & closure control [DSS01.03]				Closure checklist
DSS01	Exception handling & escalation [DSS01.02, DSS01.04–.05]				Alerts; emails
MEA01	KPI catalogue & thresholding [MEA01.01–.02]				KPI register
MEA01	Data quality & reconciliation [MEA01.03]				Reconciliation log
MEA01	Trend reviews & corrective actions [MEA01.04–.05]				Review minutes
MEA01	Conformance monitoring & audit trail [MEA01.03, MEA01.05]				Evidence binder

Each bracketed code references the exact COBIT 2019 activity statements rated in the questionnaire (see Appendix **??**). Raw item prompts are taken verbatim from COBIT and administered by role per Chapter 3.

Inter-Rater Agreement and Consensus

Inter-rater agreement is summarized with Kendall's W per domain. Values closer to 1 indicate stronger agreement. Items with low agreement were examined in a short consensus session focused on clarifying the evidence anchor; and separatin (Chowdhury et al., 2025).

Implications for Governance and Operations

Three themes emerge from the baseline: T1. Qualification & contracting (APO10). Where medians are modest and dispersion high, gaps typically reflect inconsistent qualification criteria, uneven SLA annex structure, or undefined review cadence; T2. Operational discipline (DSS01). Gaps concentrate around intake/dispatch traceability, first-time-fix discipline,

and verification/closure control—directly linked to SLA timeliness (H+4–D+2) and outcome reliability (Veena et al., 2024); and T3. Monitoring & follow-through (MEA01). Lower scores cluster around data reconciliation, thresholding, and corrective-action follow-through, signalling the need for a single source of truth and an action register (Priyono & Moin, 2020).

The implications set the order of work for Chapter 3: Section will present SWA vendor scores for rationalisation 10→5 within a 12-vendor pool, followed byrobustness checks; Section summarises SOP baselines (DSS01) and monitoring artefacts (MEA01); Section 4.5 details the staged roadmap.

SWA Vendor Scoring Results

This section reports composite vendor scores computed with the Simple Weighted Average (SWA) defined in Chapter 2 and operationalized in Chapter 3. Global weights are: History 0.30 (SLA by service types 0.25; warning letters 0.05), Pricing 0.30 (pricing mechanism 0.15; TCO 0.15), Questionnaire 0.35 (Legal 0.05, Operational 0.10, Technical 0.08, Workforce 0.07, Risk 0.05), and Bonus 0.05. All indicators were normalized to [0, 1] prior to aggregation, exactly as specified in Section

Composite Scores and Ranking

Implication of single pricing. In this tender, all vendors receive the same Pricing score (both pricing mechanism and TCO are fixed). Let Pconst ∈ [0, 1] denote that common normalised value. Then Si = 0.30 Pconst + 0.25 History i + 0.05 Warni + 0.35 Questionnaire i + 0.05.

Because 0.30 Pconst is identical for all i, ordering by Si is exactly the same as ordering by Ri (or by the shifted score Si − 0.30 Pconst). For transparency, we still report the Pricing column, but ranking and tie-breaks use Si (which is equivalent to Ri). Vendors are ranked by Si = ∑k wk si,k. For rationalization, the top five are retained from the incumbent set of ten; ties are resolved by higher SLA compliance and then lower MTTR. The tender evaluates 12 candidates (10 incumbents + 2 entrants) under the same architecture; entrants are marked with †.

History combines SLA buckets (Install, Init, Maintenance, QRIS) with workload shares (0.25 of total) and the warning-letter map (0.05 of total). Pricing averages the pricing-mechanism transparency score (0.15) and the TCO normalisation (0.15). Questionnaire is the weighted sum of Legal (0.05), Operational (0.10), Technical (0.08), Workforce (0.07), and Risk (0.05). Bonus is binary (0 or 1) multiplied by 0.05. Scores are on [0, 1]. † denotes new entrants evaluated with the provisional history policy in Section Note (single pricing). The Pricing column is constant for all vendors in this tender; it is included for completeness but does not influence the ranking because it adds the same constant 0.30 Pconst to every Si (Setyoso et al., 2024).

Table 3. SWA summary by vendor: block scores, composite Si, rank and decision

Vendor	History	Pricing	Questionnaire	Bonus	S_i
Vendor A	75.48	95	90	0	82.64
Vendor B	81	95	92	0	85
Vendor C	80.57	95	95	100	90.92
Vendor D	82.74	95	90	100	89.82
Vendor E	70.51	95	85	0	79.40
Vendor F	69.76	95	88	0	80.23
Vendor G	73.81	95	95	0	83.89
Vendor H	77.08	95	87	0	82.07
Vendor I	84.83	95	80	100	86.95
Vendor j	74.26	95	75	0	77.03
Vendor K‡	80	95	93	0	85
Vendor L†	70	95	75	0	68.75

Contribution Analysis (Top Five)

To keep decisions auditable, Table shows, for the five retained vendors, each block's contribution (weight × block score) and the composite Si (Choudhuri, 2024). Two entrants are evaluated. Vendor K is a Recognised Subcontractor (RSC): documentary evidence and ticket linkages allow attribution of past work to K over the last 12 months with sufficient coverage; therefore its History (0.30) is computed from those attributed records exactly as for incumbents. Vendor L remains a new entrant and uses the provisional-history policy (0.20 attestations + 0.10 pilot if available; missing portions = 0). Both entrants are marked in Table 4.3: K with ‡ (RSC) and L with †(no internal history) (Siyi et al., 2023).

Table 4. Contribution breakdown for retained vendors (weight × block score)

Vendor	History (0.30)	Pricing (0.30)	Questionnaire (0.35)	Bonus (0.05)	S_i
Vendor C	80.57	95	95	100	90.92
Vendor D	82.74	90	95	100	89.82
Vendor I	84.83	80	95	100	86.95
Vendor (new)	80	93	95	0	85
Vendor B	81	92	95	0	85

Decision Outcome

Applying the ranking and tie-breaks yields five retained vendors (Table 4). The remaining incumbents proceed to rationalisation. Section examines robustness (prioritisation floors, ± 10% weight sensitivity with renormalisation, and fairness via distance-adjusted response/repair indices) before the results are finalised (Singh et al., 2024).

Robustness and Validation

To ensure that the vendor rationalisation outcome in Sectionis both reliable and defensible, robustness checks were performed along three dimensions: prioritisation floors, weight sensitivity, and fairness adjustments. These checks ensure that the retained set of vendors is not the result of incidental scoring artefacts, but reflects a stable decision consistent with governance objectives. In addition, several non-standard practices were discovered during the assessment process. In addition, Appendix captures an unstandardised organisational structure discovered during the assessment process. Rather than serving as a baseline, this finding evidences the lack of alignment between vendor field operations and central SOP guidance. Highlighting this deviation strengthens the argument for enforcing organisational standardisation as part of the improvement roadmap (Cichosz et al., 2020).

Prioritisation Floors

The first robustness test applied absolute performance thresholds to confirm that retained vendors meet minimum service expectations. The criteria were aligned to the service-level definitions in Chapter namely and to operational findings during 2024–2025, SLA Compliance Floor: Vendors must achieve ≥ 95% monthly SLA compliance across install, initialise, maintenance, and QRIS service types. Trend Stability: A non-negative trend over the last three months, ensuring no systematic decline.

The five retained vendors met both criteria. Vendors falling below this minimum threshold were not considered for retention, even if their SWA scores placed them above the minimum threshold. This reflects operational findings that warning letters, BCP gaps, and SOP violations (e.g., false education claims, missing exam cards, and inaccurate job order updates) are strong predictors of future poor performance and should therefore disqualify candidates from final selection (Tu et al., 2024).

Sensitivity to Weight Variations

The second robustness check varied the weights of the SWA blocks by ± 10% and re-normalised to 100%. Across these perturbations, the ranking of the retained set remained stable, with no vendor outside the top five entering the retained group. This stability indicates that the decision is not highly sensitive to small changes in managerial preferences about weight importance, and therefore the rationalisation outcome is resilient to reasonable shifts in emphasis between history, questionnaire, and bonus criteria (Setyoso et al., 2024).

Fairness and Distance Adjustment

The third robustness check introduced fairness adjustments using distance-adjusted response and repair indices. This adjustment ensures that vendors operating in more remote areas are not structurally disadvantaged in comparison to those concentrated in urban centres. After applying this adjustment, the top five retained vendors remained unchanged, indicating that the decision is not biased against vendors with wider geographic coverage.

Conclusion of Robustness Checks

Together, these robustness checks confirm that the rationalisation decision is both stable and fair. The retained vendor set remains the same under stricter SLA floors, under weight sensitivity, and after fairness adjustments. This finding supports the governance principle of transparency and defensibility in vendor management. It also responds to the operational issues identified in Chapter 2 and 3, including the absence of BCP provisions in certain regions, the recurrence of reprimand letters, and unstandardised technician and stock practices. By confirming the integrity of the rationalisation outcome, the robustness checks close the loop between governance (APO10), operations (DSS01), and monitoring (MEA01) (Qizam et al., 2024).

SOP Baselines (DSS01)

While vendor rationalisation addresses governance and monitoring aspects (APO10 and MEA01), the sustainability of operational improvements depends on standardising execution. Within DSS01 (Managed

Operations), two critical Standard Operating Procedures (SOPs) were reviewed: Technician SOP and Stock/Inventory SOP (Grzegorowski et al., 2023). Both SOPs were previously fragmented, inconsistently applied across vendors, and identified as sources of performance variability in 2024–2025. Establishing a clear SOP baseline addresses these issues and creates a reference for monitoring. Detailed SOP structures and vendor organisation baselines are available in Appendices A.10, A.11.

Technician SOP

The Technician SOP covers the full lifecycle of on-site operations, including: Preparation and Standard Interaction (*Naskah Percakapan Standar*/NPS): Technicians must conduct pre-job checks and follow scripted communication with merchants; Job Order Execution: Detailed procedures exist for installation, initialisation, maintenance, withdrawal, proactive canvassing, and event-related job orders; and Verification and Closure: Technicians must complete evidence-based closure checklists (e.g., photos, logs, test card scans) to ensure accuracy.

Technician uniform standardisation, as documented in Appendix A.7, strengthens SOP compliance. Findings from reprimand letters highlighted systemic weaknesses, such as incorrect education claims, evidence falsification, lost test cards, and failure to update job-order status. These gaps are directly mapped to SOP clauses. The baseline therefore reinforces mandatory adherence, digital timestamping (H+4 response, D+2 repair), and escalation triggers for deviations.

Inventory SOP

The Stock SOP governs warehouse and distribution processes, including: Receiving and Sorting: Accurate logging and segregation of new arrivals. Storage and Security: Maintenance of warehouse conditions, K3 (safety), and cleanliness standards. Stock Opname (SO): Daily and monthly reconciliations between physical stock and system records. Retuns and Disposal: Defined processes for return-to-bank, refurbishment, and scrapping.

Operational audits revealed anomalies such as unreported daily stock, late stock opname, and mismatches in reporting. These weaknesses created risks of inventory distortion and impaired the ability to dispatch devices on time. Establishing the SOP baseline ensures uniform daily stock reporting, QR-coded system reconciliation, and accountability for discrepancies.

Implications

By formalising these SOP baselines, PT. XYZ addresses the operational dispersion observed under DSS01. Technician-related reprimands are reduced by enforcing standard closure evidence, while inventory irregularities are minimised through consistent stock opname. Together, these baselines create a platform for consistent vendor performance, enabling MEA01 monitoring mechanisms to function effectively. Governance reinforcement is further illustrated through technician reprimand letters in Appendix.

Monitoring and Roadmap (MEA01)

The final component of the governance–operations–evaluation framework is monitoring and continuous improvement, as represented by COBIT 2019 MEA01 (Performance and Conformance). The baseline assessment revealed persistent weaknesses in KPI thresholding, reconciliation, and follow-through on corrective actions. To address these, PT. XYZ is developing a centralised monitoring framework underpinned by business dashboards and data integration initiatives. As shown in Appendix A.6, the BCP mapping highlights how vendor allocation was previously concentrated in single providers without redundancy. This finding reinforces the governance gap identified in SLA risk management and justifies the introduction of a dual-vendor hub process to strengthen operational resilience. This section outlines the design principles, monitoring artefacts, and roadmap for implementation.

Monitoring Design Principles

Three principles guide the monitoring framework: Operational System Integration: Capture transactional and operational data from multiple sources (ticketing, stock, financial, and vendor systems) into a central platform; Centralised Data Warehouse: Consolidate evidence into a single source of truth, eliminating inconsistencies across vendor reports and internal reconciliations; and Business Dashboards: Provide near-real-time visibility for managers and executives on SLA compliance, vendor performance, inventory health, and financial metrics.

Dashboard Artefacts

The mock-up dashboard (Appendix A) demonstrates the intended functionality for MEA01 monitoring A.8. Key features include: Service Management: Monitoring job orders by type (install, init, maintenance, withdrawal, QRIS), SLA achievement, escalation alerts, and longest-pending tasks; Vendor Management: Tracking SLA compliance, penalties, warning letters, vendor QC outcomes, and capacity utilisation; Stock and Asset Management: Forecasting machine availability, daily stock opname, machine recycling, peripheral readiness, and survival analysis for machine allocation; and Financial Oversight: Budget vs.

realisation, invoice tracking, and forecasting of future costs.

Dashboards are refreshed daily (operational) and weekly (forecast), with thresholds and survival rules embedded to flag anomalies in advance.

Roadmap (2025–2027)

Implementation will occur in three phases: Short-Term (2025): Establish operational system pipelines, pilot SLA deployment dashboard for JO monitoring, and introduce a KPI catalogue aligned to COBIT items; Medium-Term (2026): Deploy centralised data warehouse, launch vendor management dashboards, and begin automation of reconciliation across SOP-driven activities; and Long-Term (2027): Fully deploy integrated business dashboards, embed corrective action registers, and hieve COBIT maturity targets: APO10 at 3.8, DSS01 sustained at ≥3.0, and MEA01 raised to ≥ 2.7.

Implications

This roadmap ensures that monitoring is not confined to retrospective audits but becomes a proactive, predictive capability. The integration of dashboards supports evidence-based governance, addresses previously noted weaknesses (e.g., absence of BCP, unstandardised reporting, reprimand triggers), and ensures that vendor rationalisation decisions remain enforceable and transparent over time.

Conclusion

This study aimed to address vendor management challenges in the EDC supply chain at PT. XYZ, where governance inconsistencies, operational variability, and limited monitoring capabilities were identified as critical problems. Using the Governance–Operations–Evaluation (G-O-E) framework derived from COBIT 2019 (APO10, DSS01, MEA01), the research objectives, research questions, and hypothesis were systematically examined. RQ1 (Baseline capability maturity): The assessment showed APO10 at median 1.8, DSS01 at 3.0, and MEA01 at 1.7. This confirmed weak governance and monitoring practices, while operational execution was above minimum target levels. RQ2 (Gap to COBIT targets): APO10 had a gap of –2.0, MEA01 –1.0, while DSS01 slightly exceeded its target (+0.1). This demonstrated that vendor management and monitoring require urgent reinforcement. RQ3 (Vendor rationalization using SWA): The composite scoring confirmed that PT. XYZ can rationalize from 10 vendors down to 5 (or 4 in the EDV 2025 roadmap). Robustness checks validated that this decision was stable under SLA floors, weight sensitivity, and fairness adjustments. RQ4 (SOP and monitoring changes): Standardized Technician and Stock SOP baselines were established, addressing root causes of reprimand letters and unstandardized practices. In parallel, a dashboard-driven monitoring roadmap was designed for 2025–2027, ensuring proactive SLA tracking and data reconciliation. Hypothesis Testing: The results support the hypothesis (H1) that applying APO10, DSS01, and MEA01 with structured SOPs and a transparent vendor scoring model improves SLA adherence. Evidence includes the identification of operational weaknesses, closure of governance and monitoring gaps, and design of dashboards to enforce accountability. In conclusion, the research successfully met its objectives and demonstrated that the proposed framework provides a structured, practical pathway for improving vendor management maturity, rationalizing vendors, and embedding transparency in performance monitoring.

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Author Contributions

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Conflicts of Interest

The researcher has no affiliation with or involvement in any organization or entity with a financial interest (such as a fixed honorarium; educational grant or other equity interest).

References

Ahmad, N., Haque, S., & Islam, M. A. (2024). Modern Slavery Disclosure Regulations in the Global Supply Chain: A World-Systems Perspective. *Critical Perspectives on Accounting*, *99*, 102677. https://doi.org/10.1016/j.cpa.2023.102677

Ariyanti, F. D., Russell, A., & Setiawan, L. (2021). Vendor Management System Improvement Using PDCA

and Optimizing Transporter Vendor Selection Using Fuzzy Analytical Hierarchy Process. *IOP Conference Series: Earth and Environmental Science*, *794*(1), 12077. https://doi.org/10.1088/1755-1315/794/1/012077

Barrane, F. Z., Ndubisi, N. O., Kamble, S., Karuranga, G. E., & Poulin, D. (2021). Building Trust in Multi-Stakeholder Collaborations for New Product Development in the Digital Transformation Era. *Benchmarking: An International Journal*, *28*(1), 205–228. https://doi.org/10.1108/BIJ-04-2020-0164

Bolívar, M. P. R., & Meijer, A. J. (2016). Smart Governance: Using a Literature Review and Empirical Analysis to Build a Research Model. *Social Science Computer Review*, *34*(6), 673–692. https://doi.org/10.1177/0894439315611088

Boone, T., Fahimnia, B., Ganeshan, R., Herold, D. M., & Sanders, N. R. (2025). Generative AI: Opportunities, Challenges, and Research Directions for Supply Chain Resilience. *Transportation Research Part E: Logistics and Transportation Review*, *199*, 104135. https://doi.org/10.1016/j.tre.2025.104135

Chidozie, B., Ramos, A., Ferreira, J., & Ferreira, L. P. (2024). The Importance of Digital Transformation (5.0) in Supply Chain Optimization: An Empirical Study. *Production Engineering Archives*, *30*. https://doi.org/10.30657/pea.2024.30.12

Choudhuri, S. S. (2024). *AI in ERP and Supply Chain Management*. Academic Guru Publishing House.

Chowdhury, A. R., Limon, G. Q., & Rahman, M. A. (2025). Predictive Analytics for Apparel Supply Chains: A Review of MIS-Enabled Demand Forecasting and Supplier Risk Management. *American Journal of Interdisciplinary Studies (AJIS)*, *05*(04), 1–23. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5227219

Cichosz, M., Wallenburg, C. M., & Knemeyer, A. M. (2020). Digital Transformation at Logistics Service Providers: Barriers, Success Factors and Leading Practices. *International Journal of Logistics Management*, *31*(2), 209–238. https://doi.org/10.1108/IJLM-08-2019-0229

Doymus, M., Sakar, G. D., Yildiz, S. T, & Acik, A. (2022). Small-Scale LNG Supply Chain Optimization for LNG Bunkering in Turkey. *Computers & Chemical Engineering*, *162*, 107789. https://doi.org/10.1016/J.Compchemeng.2022.107789

Furkan, L. M., Agusdin, A., Suryani, E., Fadliyanti, L., Imanuella, R., & Muhdin, M. (2021). Open Innovation in Service Industry. *2nd Annual Conference on Education and Social Science (ACCESS 2020)*, 149–156. https://doi.org/10.2991/assehr.k.210525.064

Grzegorowski, M., Litwin, J., Wnuk, M., Pabiś, M., & Marcinowski, Ł. (2023). Survival-Based Feature Extraction—Application in Supply Management for Dispersed Vending Machines. *IEEE Transactions on Industrial Informatics*, *19*(3), 3331–3340. https://doi.org/10.1109/TII.2022.3178547

Haritiantari, D., Hamzani, U., Desyana, G., & Indah, D. P. (2024). Financial Accounting Financial Accounting Strategy for Sustainable Development of MSMEs in Indonesia: MSMEs, Financial Accounting, Digital Transformation. *Urnal Penelitian Ekonomi dan Akuntansi*, *1*(1). https://doi.org/10.29259/jscs.v1i1.12

Huang, P.-L., Lee, B. C. Y., & Chen, C.-C. (2019). The Influence of Service Quality on Customer Satisfaction and Loyalty in B2B Technology Service Industry. *Total Quality Management & Business Excellence*, *30*(13–14), 1449–1465. https://doi.org/10.1080/14783363.2017.1372184

Jafari-Sadeghi, V., Garcia-Perez, A., Candelo, E., & Couturier, J. (2021). Exploring the Impact of Digital Transformation on Technology Entrepreneurship and Technological Market Expansion: The Role of Technology Readiness Exploration and Exploitation. *Journal of Business Research*, *124*, 100–111. https://doi.org/10.1016/j.jbusres.2020.11.020

Kassim, N., Karuppiah, K., Abidin, E. Z., & Tamrin, S. B. M. (2019). Latex Glove Industry: Prevalence of Heat‐Related Illness Among Malaysian Workers. *Human Factors and Ergonomics in Manufacturing & Service Industries*, *29*(2), 172–176. https://doi.org/10.1002/hfm.20771

Kaul, D., & Khurana, R. (2022). AI-Driven Optimization Models for E-Commerce Supply Chain Operations: Demand Prediction, Inventory Management, and Delivery Time Reduction with Cost Efficiency Considerations. *International Journal of Social Analytics*, *7*(12), 59–77. Retrieved from https://shorturl.asia/qj6xZ

Khoo, K. L. (2022). A Study of Service Quality, Corporate Image, Customer Satisfaction, Revisit Intention and Word-of-Mouth: Evidence from the KTV Industry. *PSU Research Review*, *6*(2), 105–119. https://doi.org/10.1108/PRR-08-2019-0029

Khotimah, K., Karnati, N., & Sutjipto, S. (2022). Good Governance in Education Department Indonesia: Balanced Scorecard Framework. *International Journal of Social Science Research and Review*, *5*(5), 13–22. https://doi.org/10.47814/ijssrr.v5i5.269

Li, L. (2022). Digital Transformation and Sustainable Performance: The Moderating Role of Market Turbulence. *Industrial Marketing Management*, *104*, 28–37. https://doi.org/10.1016/j.indmarman.2022.04.007

Martinez-Valencia, L., Garcia-Perez, M., & Wolcott, M.

P. (2021). Supply Chain Configuration of Sustainable Aviation Fuel: Review, Challenges, and Pathways for Including Environmental and Social Benefits. *Renewable and Sustainable Energy Reviews*, *152*, 111680. https://doi.org/10.1016/j.rser.2021.111680

Maulana, F. R. (2024). From Traditional to Digital: Exploring the Online Marketing Transformation of Culinary Micro, Small, and Medium Enterprises (MSMEs) in Karawang Indonesia. *Open Access Indonesia Journal of Social Sciences*, *7*(5), 1773–1788. https://doi.org/10.37275/oaijss.v7i5.269

Oguche, H. (2018). *Managing Supply Chain Disruptions in Nigerian Seaport Companies*. Walden University.

Pestronk, M., Johnson, D., Muthanna, M., Montano, O., Redkar-Brown, D., Russo, R., Kerkar, S., & Eade, D. (2021). Electronic Data Capture-Selecting an EDC System. *Journal of the Society for Clinical Data Management*, *1*(1). https://doi.org/10.47912/jscdm.29

Priyono, A., & Moin, A. (2020). Identifying Digital Transformation Paths in the Business Model of SMES During the Covid19 Pandemic. *Journal of Open Innovation: Tecnology, Market, and Complexity*, *6*(4), 104. https://doi.org/10.3390/joitmc6040104

Purwanto, A., Purba, J. T., Sijabat, R., & Bernarto, I. (2021). The Role of Transformational Leadership, Organizational Citizenship Behaviour, Innovative Work Behaviour, Quality Work Life, Digital Transformation and Leader Member Exchange on Universities Performance. *Linguistica Antverpiensia*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3987666

Qizam, I., Berakon, I., & Ali, H. (2024). The Role of Halal Value Chain, Sharia Financial Inclusion, and Digital Economy in Socio-Economic Transformation: A Study of Islamic Boarding Schools in Indonesia. *Journal of Islamic Marketing*. https://doi.org/10.1108/JIMA-03-2024-0108

Rainy, T. A., & Chowdhury, A. R. (2022). The Role of Artificial Intelligence in Vendor Performance Evaluation Within Digital Retail Supply Chains: A Review of Strategic Decision-Making Models. *American Journal of Scholarly Research and Innovation*, *01*(01), 220–248. https://doi.org/10.63125/96jj3j86

Rawat, R., Ayodele Oki, O., Sankaran, S., Florez, H., & Ajagbe, S. A. (2023). Techniques for Predicting Dark Web Events Focused on the Delivery of Illicit Products and Ordered Crime. *Int. J. Electr. Comput. Eng.(IJECE)*, *13*(5), 5354–5365. https://doi.org/10.21203/rs.3.rs-1665267/v1

Saleem, U., Yi, S., Bilal, M., Topor, D. I., & Căpuşneanu, S. (2022). The Impact of Website Quality on Customer Satisfaction and eWOM in Online Purchase Intention: The Moderating Role of Gender in Risk-Taking. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.945707

Salunke, N. (2024). Cost Optimization in Supply Chain Management Leveraging Vendor Development and Sourcing Strategies. *Journal of Business and Management Studies*, *6*(5), 225–237. https://doi.org/10.32996/Jbms.2024.6.5.24

Santoso, R., Purwoko, B., Umar, H., & Renwarin, J. M. (2020). The Effect of Business Environment on the Corporate Performance Through Business Strategies in the Construction Service Industry in DKI Jakarta, Indonesia. *International Journal of Managerial Studies and Research*, *8*(4), 1–12. https://doi.org/10.29313/amwaluna.v6i2.9122

Setyoso, A. A., Mulyana, R., & Nugraha, R. A. (2024). Utilizing ISO 27001:2022 in Information Security Design for BPRCCo SME Digital Transformation. *Ranah Research: Journal of Multidisciplinary Research and Development*, *6*(6), 2544–2553. https://doi.org/10.38035/rrj.v6i6.1121

Sinaga, B., & Rajagukguk, J. (2022). Academic Perspective for Digital Transformation of Higher Education in Postgraduate School of Universitas Negeri Medan. *Proceedings of the 7th Annual International Seminar on Transformative Education and Educational Leadership*. Retrieved from https://digilib.unimed.ac.id/id/eprint/53340/

Singh, R., Mandal, P., & Nayak, S. (2024). Reinforcement Learning Approach in Supply Chain Management. In *How Machine Learning is Innovating Today's World* (pp. 271–302). Wiley. https://doi.org/10.1002/9781394214167.ch17

Siyi, C., Yu, Q., & Al-Samawi, A. (2023). Effects of Digital Education on Human Resource Development. *Human Systems Management*, *42*(6). https://doi.org/10.3233/HSM-230111

Soegoto, E. S., Luckyardi, S., Hayati, E. N., Rafdhi, A. A., & Okatafiani, D. (2022). Bibliometric Analysis of Green Supply Chain Research Using Vosviewer. *Journal of Eastern European and Central Asian Research (JEECAR)*, *9*(5), 851–864. https://doi.org/10.15549/Jeecar.V9i5.1051

Tarannum, T., & Zghair, H. (2024). Development and Implementation of a Standardized Supplier Certification and Validation Framework for Enhanced Pricing, Lead Time, and On-Time Delivery Performance. *9th North American Conference on Industrial Engineering and Operations Management*. https://doi.org/10.46254/NA09.20240090

Tomor, Z., Meijer, A., Michels, A., & Geertman, S. (2019). Smart Governance for Sustainable Cities: Findings from a Systematic Literature Review. *Journal of Urban Technology*, *26*(4), 3–27.

https://doi.org/10.1080/10630732.2019.1651178

Tu, Y., Li, W., Song, X., Gong, K., Liu, L., Qin, Y., Liu, S., & Liu, M. (2024). Using Graph Neural Network to Conduct Supplier Recommendation Based on Large-Scale Supply Chain. *International Journal of Production Research*, *62*(24), 8595–8608. https://doi.org/10.1080/00207543.2024.2344661

Veena, G., B Balamurugan, B., Mariofanna, M., & A Yovan, F. (2024). *Blockchain, IoT, and AI technologies for Supply Chain Management: Apply Emerging Technologies to Address and Improve Supply Chain Management*. Springer. https://doi.org/10.1007/979-8-8688-0315-4

Velly, R. L., Goulet, F., & Vinck, D. (2022). Allowing for Detachment Processes in Market Innovation. The Case of Short Food Supply Chains. In *Market Detachment* (pp. 7–22). Routledge.

Wachyudi, T., Daryanto, A., Machfud, M., & Arkeman, Y. (2020). Biofuel Supply Chain Risk Mitigation Strategy Framework: Expert Interview Based Approach. *Journal of Industrial Engineering and Management*, *13*(1), 179. https://doi.org/10.3926/jiem.2812

Yin, J., & Song, H. (2023). Does the Perception of Smart Governance Enhance Commercial Investments? Evidence from Beijing, Shanghai, Guangzhou, and Hangzhou. *Heliyon*, *9*(8), e19024. https://doi.org/10.1016/j.heliyon.2023.e19024

Zhu, Y., Zhou, L., Xie, C., Wang, G. J., & Nguyen, T. V. (2022). Forecasting SMEs' Credit Risk in Supply Chain Finance with an Enhanced Hybrid Ensemble Machine Learning Approach. *International Journal of Production Economics*, *211*(September 2018), 22–33. https://doi.org/10.1016/j.ijpe.2019.01.032