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POS System Success Evaluation at a Civil Servants Cooperative: DeLone-McLean Evidence and Perceived Paperless Environmental Benefits

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Abstract: Information system success models define net benefits mainly in economic and operational terms, leaving the environmental implications of digitalization insufficiently addressed. This study evaluated a centralized Point of Sale (POS) system at the Civil Servants' Cooperative of Politeknik Negeri Bali using the DeLone and McLean model and examined whether perceived paperless environmental benefit could qualify as an additional net-benefit dimension. A mixed-methods evaluative design involved customers ($N = 78$), tenants ($N = 12$), and managers ($N = 7$). Analyses included validity and reliability testing, correlation analysis, robust path analysis, mediation testing, and the Wilcoxon signed-rank test. Of eighteen stakeholder-specific scales, reliability was adequate for customer scales ($\alpha = 0.888\text{--}0.961$) but unstable for tenant and manager scales, with confidence intervals extending to $[0.271, 0.952]$. Queue management and comfort were significantly associated with customer satisfaction ($\beta = 0.683, p < 0.001; R^2 = 0.715$), while satisfaction was associated with PPEB ($\beta = 0.773, p < 0.001$). Mediation evidence was inconclusive: the indirect path was significant under classical standard errors (Sobel $z = 2.31$) but not under heteroscedasticity-consistent errors ($z = 1.59, p = 0.111$), while the direct association remained strong. Sales declined after implementation, but differing measurement bases prevented causal interpretation.

Keywords: Cooperative Digitalization, DeLone and McLean Model, Paperless Operations, Information System Success, Point of Sale

1. Introduction

Digital transformation is a major driver of organisational efficiency, transparency, and service quality. Information systems enable faster service, more accurate recording, and real-time operational data [1]. In the retail and food service sectors, Point of Sale (POS) systems play a central role in managing sales transactions, payments, inventory records, and operational reporting. Beyond improving transaction speed and accuracy, POS systems may also influence customer experience and the work processes of front line employees [2], [3], [4]. In parallel, transaction digitalization is increasingly recognized as a mechanism for supporting environmental sustainability by reducing paper consumption and facilitating the transition from paper-based documentation to digital records [5], [6]. In the accounting literature, green accounting refers to the recognition, measurement, and reporting of environmental costs, savings, assets, liabilities, or performance indicators within an accounting system [7] [8]. Environmental management accounting represents the managerial dimension of this practice [8]. Digital accounting concerns the ways in which digitalisation affects accounting information, processes, and methods [6], whereas green information systems refer to information technologies designed and used to support environmental objectives [9]. Paperless operations, by contrast, describe a reduction in the use of physical materials and do not, in themselves, constitute an accounting category. Accordingly, this study examines users' perceptions of such changes and adopts the term perceived paperless environmental benefit. It

does not claim to measure green accounting, as no environmental costs, savings, or liabilities were formally recognised in the cooperative's accounting records during the study period.

As member-based enterprises, cooperatives are increasingly expected to strengthen their business management practices through the effective adoption of information technology. Previous studies involving micro, small, and cooperative enterprises in Indonesia have reported improvements in recording accuracy, organizational transparency, and operational efficiency following digitalisation [10], [11], [12], [13]. Nevertheless, limited technological literacy and inadequate system integration continue to present significant challenges [11], [14]. The Civil Servants' Cooperative of Politeknik Negeri Bali (KPN PNB) operates a canteen unit comprising twelve tenants. Prior to digitalisation, customers placed their orders directly with individual tenants and subsequently queued at a central cashier to complete payment. This two-stage transaction process increased waiting times, particularly during peak service periods, required the continued use of paper coupons, and created opportunities for revenue leakage arising from unpaid coupons. In January 2026, KPN PNB implemented a centralized retail Point of Sale (POS) system that enables transactions to be processed directly at each tenant. The system integrates transaction data in real time, automatically calculates revenue sharing fees, and supports cashless payments through QRIS [15]. However, the implementation of an information system does not, by itself, ensure successful outcomes. Information system success must be evaluated empirically based on system quality and the benefits generated through its use [16]. The DeLone and McLean Information System Success Model remains one of the most widely applied frameworks for this purpose, linking system quality, information quality, and service quality with system use, user satisfaction, and net benefits [1]. Recent Indonesian studies have applied the model to the evaluation of academic information systems [18].

Two theoretical considerations underpin the customer-side evaluation model. First, canteen customers do not interact directly with the POS interface but experience the outcomes of the system through services provided by the tenants. Accordingly, they are conceptualized as service recipients rather than direct system users. From this perspective, service quality is the dimension of the DeLone and McLean model that can be most appropriately assessed by customers, whereas system quality and information quality require direct interaction with the system. Second, the proposed relationship between customer satisfaction and perceived environmental benefit is grounded in Bhattacharjee's expectation-confirmation perspective, whose principal relationships have subsequently been supported through meta-analytic evidence [19]. Within the present context, customers who are satisfied with the digitalized transaction service are expected to recognize and positively evaluate its visible material consequence, namely the elimination of paper coupons. This relationship represents a perceptual mechanism rather than a formal accounting mechanism. The present study therefore examines whether customer satisfaction is associated with perceived paperless environmental benefit and whether the proposed mediation pathway is empirically supported.

This study makes three principal contributions. First, it evaluates a centralized retail Point of Sale (POS) system within a cooperative using a three-stakeholder design involving customers, tenants, and managers, with the findings triangulated against transaction records. Second, it examines whether perceived paperless environmental benefit (PPEB) functions as a distinct dimension of net benefits and formally tests the mediation pathway that previous model extensions have tended to assume rather than examine empirically. Third, it identifies a measurement-basis problem that may render simple pre- and post-implementation sales comparisons misleading in cooperative settings. Accordingly, the study investigates how stakeholders perceive the quality and benefits of the POS system, how the customer-side constructs are related, and whether the available operational records provide an adequate basis for drawing conclusions regarding operational efficiency.

2. Literature Review

A. Literature Search Scope

The literature was examined through a structured narrative review rather than a systematic review. Scopus, Google Scholar, Garuda, and DOAJ were searched between January and May 2026 using terms related to the DeLone and McLean model, information system success, environmental accounting, paperless operations, POS systems, and cooperatives. The review included peer-reviewed English- and Indonesian-language articles published from 2016 to 2026 that either applied the model empirically or examined environmental aspects of accounting digitalisation. As the review was not exhaustive, the research gap is interpreted within the applied databases, search terms, publication period, and eligibility criteria.

B. The DeLone and McLean Model and Its Net-Benefits Construct

The DeLone and McLean Information System Success Model comprises six interrelated dimensions and was later revised to include service quality and consolidate individual and organizational impacts into a single net-benefits construct [1]. Subsequent studies have shown that relationships among the model's constructs vary across organizational, technological, and user contexts, while the model has been widely adapted across different domains [16]. Net benefits remain the least standardized dimension because their operationalization depends on the objectives and context of the evaluated system. This flexibility permits contextual extensions, provided that each proposed dimension is conceptually justified and explicitly defined.

C. Distinguishing Adjacent Literatures

Several related bodies of literature are often treated as interchangeable despite their distinct conceptual scopes. Green accounting concerns the recognition, measurement, and reporting of environmental items within formal accounting systems [7], [8], whereas environmental management accounting focuses on environmental cost information for internal planning and decision-making [8]. Digital accounting examines how digital technologies transform accounting information and processes [6]. Green information systems refer to information technologies developed or used to support environmental objectives [9], while sustainability performance management translates sustainability strategies into measurable organizational outcomes [20]. Paperless operational benefit refers to reductions in physical-material use resulting from process digitalization. Unlike green accounting, such benefits may not be formally recognized or reported within accounting systems. This comparatively underdeveloped domain constitutes the focus of the present study. Previous research on accounting-integrated information systems [9] and blockchain-based auditing [21] has reported environmental gains from digitalization, but generally treats them as technological outcomes rather than benefits whose realization may depend on user acceptance and satisfaction.

D. Prior Applications and Research Gap

Table 1 summarizes recent Indonesian applications of the DeLone and McLean model [17], [18], [22], [23], which has also been widely examined in learning management systems [24]. Existing studies commonly position user satisfaction as an intermediary between system-quality dimensions and net benefits, while operationalizing net benefits primarily in economic, service, or operational terms. Within the scope of the structured narrative review, no retrieved study evaluated a POS system in a cooperative or examined perceived environmental benefit as a distinct net-benefit dimension. The novelty of this study is therefore limited to evaluating a cooperative-based POS system and the perceptual environmental benefit measured. It does not claim to measure or extend green accounting as formally defined in the accounting literature.

Table 1. Summary of Prior Studies Applying the DeLone and McLean Model

No	Author	Context	Method	Key Finding	Limitation Addressed Here
1	Sumariani et al. (2026) [17]	Academic IS, Bali Tourism Polytechnic	PLS-SEM, N=102	Information quality strongest for satisfaction	Net benefits limited to service efficiency
2	Aryani et al. (2025) [18]	PLN Mobile utility application	SEM-AMOS, N=150	Satisfaction reported as mediator	Single group; no objective records
3	Nifu et al. (2026) [22]	MyASN civil servant application	TAM + IS Success	Acceptance and success jointly explain mandatory use	No organisational outcome measure
4	Faris et al. (2024) [23]	SIDEMANG e-government app	SmartPLS, N=97	Information and system quality not significant	Benefits not quantified

3. Methods

A. Research Design, Site, and Ethical Considerations

This study employed a cross-sectional evaluative design supported by documentary data analysis at the Civil Servants' Cooperative of Politeknik Negeri Bali (KPN PNB). The evaluation was based on the DeLone and McLean Information System Success Model[1], [16]. Because the study relied on cross-sectional self-reported data, the quantitative findings are interpreted as associations rather than causal relationships. Participation was voluntary and anonymous. The questionnaire explained the study purpose, voluntary participation, and the use of data for academic research and publication, while submission indicated informed consent. Respondent names were optional and excluded from reporting. Tenant sales records were provided and authorized by the KPN PNB management board. To maintain confidentiality, tenant identities were anonymized as Tenant 1 to Tenant 6. Under institutional policy, separate ethics committee approval was not required for anonymous, non-clinical survey research; however, the absence of independent ethical review is acknowledged as a limitation.

B. Population and Sample

The service-recipient population comprised customers who had completed at least one transaction at the KPN PNB canteen after POS implementation. Eligible respondents were members of the campus community aged 17 years or older. Customers were recruited on site during operating hours using accidental sampling over eleven operating days. An a priori power analysis with two predictors, $\alpha = 0.05$, power = 0.80, and a medium effect size of $f^2 = 0.15$ indicated a minimum sample of 68 respondents. The achieved sample of $N = 78$ provided approximately 0.90 statistical power under the same assumptions. The observed effect size for the customer satisfaction model was $f^2 = 2.51$. Because the canteen served an open and changing customer population, a conventional response rate could not be calculated and is acknowledged as a limitation. Duplicate participation was minimized through one-time questionnaire-link distribution and inspection of submission timestamps and response patterns. Tenants and managers were included through complete enumeration, yielding 12 tenant respondents and seven manager and administrator respondents. All questionnaires were complete, with no missing values.

C. Constructs and Instruments

Service recipients do not interact directly with the POS interface and therefore cannot assess System Quality, Information Quality, or System Use. Their evaluation is based on the service delivered through the tenants. Accordingly, the customer instrument measured Service Quality through two context-specific facets, Ease and Speed (ES) and Queue and Comfort (QC),

together with Customer Satisfaction (CS) and Perceived Paperless Environmental Benefit (PPEB). Tenants and managers, as direct system operators, were assessed using instruments covering all six dimensions of the DeLone and McLean model. Table 2 presents the construct mapping. All items used a five-point Likert scale. Items for the established model dimensions were adapted from the DeLone and McLean constructs and previous applications [1], [14]. As no validated PPEB scale was identified, four items were developed from the accounting-digitalisation literature [5], [7], covering reduced coupon use, physical documentation, digital reporting, and administrative-resource consumption. Their lack of prior external validation is acknowledged as a limitation. ES and QC were treated as facets of a single nine-item Service Quality composite in the primary customer model. A separate two-facet model was retained as a robustness analysis.

Table 2. Mapping of Model Dimensions to Instruments and Item Counts

Model dimension	Service recipients	Tenants	Manager	Sample item
System Quality	not measurable	5	5	The POS system is easy to use in daily transactions
Information Quality	not measurable	5	5	Transaction data produced by the POS are accurate
Service Quality	9 (ES 5, QC 4)	4	4	Payment at the tenant is more practical
Use	not measurable	5	4	The POS is used in most daily transactions
User Satisfaction	4	4	4	I am satisfied with the current POS transaction system
Net benefit: operational efficiency	not measured	6	7	The POS speeds up transactions with customers
Net benefit: PPEB	4	5	5	The POS reduces the use of paper coupons
Total items	17	34	34	-

D. Psychometric Evidence and Its Limits

This study distinguishes between formal psychometric evidence and descriptive evidence of scale consistency. For the service-recipient sample ($N = 78$), corrected item–total correlations and Cronbach’s alpha coefficients were used to evaluate item validity and internal consistency. In addition to point estimates, 95% confidence intervals for Cronbach’s alpha were calculated using Feldt’s exact F-distribution method, as implemented in [25]. This method was selected because bootstrap confidence intervals may be unstable when applied to samples of this size. Reporting Cronbach’s alpha solely as a point estimate may obscure the uncertainty surrounding the coefficient and is increasingly considered insufficient for evaluating scale reliability [26]. For the tenant ($n = 12$) and manager ($n = 7$) instruments, Cronbach’s alpha was reported only as a descriptive indicator of internal consistency. Given the very small sizes of these populations, the sampling distributions of the reliability coefficients were expected to be wide, and item-level validity coefficients could not be interpreted reliably. Therefore, no formal psychometric claims were made for the tenant and manager instruments. Confidence intervals were nevertheless reported for all scales to make differences in the precision of the reliability estimates directly observable. This approach prevents high point estimates from being interpreted without consideration of the substantial uncertainty associated with the small tenant and manager groups.

E. Data Analysis and Model Diagnostics

Data were analysed using descriptive statistics, Pearson correlation, and ordinary least squares regression. Variance-based structural equation modelling was not applied because the customer model involved two sequential paths among observed composite variables, while the sample of 78 respondents was insufficient for estimating a complete six-construct latent model [27]. As residual normality was violated, regression results were reported using HC3 heteroscedasticity-consistent standard errors. Model diagnostics included variance inflation factor and tolerance, the Jarque–Bera test, Breusch–Pagan test, Ramsey RESET test, Cook’s distance, leverage, and studentised residuals. Mediation was examined using the Baron and Kenny causal-steps procedure, the Sobel test, and a bias-corrected bootstrap confidence interval based on 10,000 resamples [28]. Harman’s single-factor test was used as an indicative assessment of common-method variance [29]. Sensitivity analysis excluded invariant responses. Paired tenant sales were compared using the Wilcoxon signed-rank test, while open-ended responses were analysed thematically.

4. Results and Discussion

A. Respondent Characteristics

The study involved 78 service recipients, 12 tenants, and 7 managers and administrators. Most service recipients were educational staff (56.4%) and students (42.3%). Payment was dominated by a combination of cash and QRIS (74.4%), and 52.6% had previously used the coupon system, providing a basis for comparison. Tenant respondents were dominated by operators with three to six months of POS experience (66.7%).

B. Validity and Reliability

All 17 service-recipient items obtained corrected item-total correlations between 0.625 and 0.921, above the 0.223 critical value for $N=78$. Table 3 reports alpha with 95% confidence intervals for all eighteen stakeholder-specific scales. The four service-recipient scales are estimated precisely, with interval widths of 0.029 to 0.080. The tenant and manager scales are not: interval widths reach 0.249 for tenants and 0.681 for managers, where System Quality has a point estimate of 0.757 but an interval of [0.271, 0.952]. These latter values are reported as descriptive consistency indicators and are not used to support any psychometric claim, in line with Section 3.4

Table 3. Scale Statistics with 95% Confidence Intervals for Cronbach's Alpha

Group	Scale	k	alpha	95% CI	M	SD
Service recipients (N=78)	Ease & Speed	5	0.888	[0.843, 0.923]	4.07	0.73
	Queue & Comfort	4	0.934	[0.906, 0.955]	3.94	0.80
	Satisfaction	4	0.961	[0.944, 0.973]	3.95	0.84
	PPEB	4	0.936	[0.909, 0.956]	4.23	0.82
	Service Quality (9 items)	9	0.944	[0.923, 0.961]	4.01	0.73
Tenants (n=12)	System Quality	5	0.894	[0.757, 0.965]	3.98	0.85
	Information Quality	5	0.885	[0.734, 0.962]	4.33	0.53
	Service Quality	4	0.881	[0.712, 0.962]	4.54	0.51
	Use	5	0.917	[0.809, 0.973]	4.48	0.51
	Satisfaction	4	0.964	[0.914, 0.989]	4.50	0.53
	Operational Efficiency	6	0.976	[0.947, 0.992]	4.46	0.59
	PPEB	5	0.975	[0.942, 0.992]	4.18	0.78
	System Quality	5	0.757	[0.271, 0.952]	4.49	0.38
Managers (n=7)	Information Quality	5	0.944	[0.832, 0.989]	4.63	0.52
	Service Quality	4	0.920	[0.743, 0.985]	4.21	0.71
	Use	4	0.831	[0.454, 0.967]	4.57	0.43
	Satisfaction	4	0.900	[0.679, 0.981]	4.21	0.68
	Operational Efficiency	7	0.872	[0.643, 0.975]	4.49	0.61
	PPEB	5	0.888	[0.665, 0.978]	4.54	0.54

C. Descriptive Perceptions

Mean scores were high to very high across all three groups. Among service recipients PPEB scored highest ($M=4.23$, $SD=0.82$). For tenants the overall mean was 4.35, with Service Quality highest ($M=4.54$) and System Quality lowest ($M=3.98$), pointing to network stability as the weakest element. For managers the overall mean was 4.45, with Information Quality highest ($M=4.63$). Use scored high in both operator groups (tenants $M=4.48$; managers $M=4.57$). Given the sample sizes, the tenant and manager figures are descriptive summaries of a fully enumerated population rather than estimates carrying inferential precision

D. Associations among Service-Recipient Constructs

All constructs were positively and significantly correlated at the 0.01 level, with coefficients from 0.756 to 0.839 (Table 4). The nine-item Service Quality scale was internally consistent ($\alpha=0.944$) and correlated 0.830 with satisfaction and 0.834 with PPEB. The uniformly high intercorrelations are themselves a finding: they indicate limited discriminant separation among the perceptual constructs, which constrains what any regression on these data can establish.

Table 4. Pearson Correlations among Service-Recipient Constructs (N=78)

Construct	SQ	ES	QC	CS	PPEB
Service Quality (SQ, 9 items)	1	-	-	0.830**	0.834**
Ease & Speed (ES)	-	1	0.831**	0.756**	0.812**
Queue & Comfort (QC)	-	0.831**	1	0.839**	0.782**
Customer Satisfaction (CS)	0.830**	0.756**	0.839**	1	0.773**
PPEB	0.834**	0.812**	0.782**	0.773**	1

** $p < 0.01$ (two-tailed)

E. Regression Results and Diagnostics

Table 5 reports the regression results with HC3 robust standard errors, and Table 6 reports the full diagnostic set. Service Quality was strongly associated with satisfaction ($\beta=0.830$, $p<0.001$, $R^2=0.689$). In the model predicting PPEB, the direct Service Quality path remained significant ($\beta=0.619$, $p<0.001$) while the satisfaction path did not ($\beta=0.259$, $p=0.114$); together they explained 71.6% of variance. Multicollinearity was within conventional limits ($VIF=3.22$, $tolerance=0.311$), so the pattern is not attributable to a diagnostic violation. Functional form was adequate (RESET $p=0.953$) and no observation was unduly influential (maximum Cook's distance 0.239, none exceeding 1). Residual normality was rejected (Jarque-Bera $p<0.001$, kurtosis 8.03), which is why robust standard errors are used throughout. In the two-facet robustness specification, Queue and Comfort was associated with satisfaction ($\beta=0.683$, HC3 $p<0.001$) whereas Ease and Speed was not ($\beta=0.188$, HC3 $p=0.121$).

Table 5. Regression Results with HC3 Robust Standard Errors (Service Recipients, N=78)

Model / path	β	SE (HC3)	t	p	R^2
Model 1: CS ~ SQ					0.689
a: SQ $\rightarrow$ CS	0.830	0.035	23.834	<0.001	
Model 2: PPEB ~ SQ + CS					0.716
c': SQ $\rightarrow$ PPEB (direct)	0.619	0.158	3.926	<0.001	
b: CS $\rightarrow$ PPEB	0.259	0.162	1.598	0.114	
c: SQ $\rightarrow$ PPEB (total)	0.834	0.079	10.562	<0.001	0.695
Mediation, indirect $a \times b = 0.215$	OLS Sobel $z = 2.306$	$p = 0.021$	HC3 Sobel $z = 1.594$	$p = 0.111$	inconclusive
bootstrap 95% CI (20,000)	[-0.016, 0.451]	includes zero			
Robustness (CS ~ ES + QC): ES					0.715
$\beta=0.188$ $p=0.121$; QC $\beta=0.683$ $p<0.001$					

Table 6. Regression Diagnostics

Diagnostic	Criterion	CS ~ SQ	PPEB ~ SQ + CS	Assessment
Variance inflation factor	< 5	1.00	3.22	Acceptable
Tolerance	> 0.10	1.000	0.311	Acceptable
Jarque-Bera (residual normality)	$p > 0.05$	$p < 0.001$	$p < 0.001$	Violated; HC3 applied
Breusch-Pagan (homoscedasticity)	$p > 0.05$	0.986	0.010 (LM=13.256)	Addressed by HC3
Ramsey RESET (specification)	$p > 0.05$	0.953	0.953	Adequate
Cook's D (max) / studentised > 3	< 1	0.111 / 2	0.239 / 2	No influential case
Harman single factor	< 50%	69.0%	69.0%	Common-method variance present

F. Formal Mediation Test

The proposed mediation pathway was examined using the Baron and Kenny causal-steps procedure [28]. Service Quality was significantly associated with both PPEB ($c = 0.834$, $p < 0.001$) and Customer Satisfaction ($a = 0.830$, $p < 0.001$). However, evidence for the mediating role of satisfaction depended on the standard-error estimator. Under classical OLS estimation, the satisfaction-to-PPEB path was significant ($b = 0.259$, $SE = 0.110$, $p = 0.022$), and the Sobel test indicated a significant indirect effect ($z = 2.306$, $p = 0.021$). These results were not retained under HC3 heteroscedasticity-consistent estimation, for which the same path was non-significant ($SE = 0.162$, $p = 0.114$) and the Sobel test no longer supported mediation ($z = 1.594$, $p = 0.111$). The HC3 results were considered more appropriate because the Breusch–Pagan test indicated heteroscedasticity ($LM = 13.256$, $p = 0.010$), while the residuals were heavy-tailed. A bias-corrected bootstrap analysis based on 20,000 resamples also produced an indirect-effect interval containing zero ($ab = 0.215$; 95% CI $[-0.016, 0.451]$), consistently across five replications. The direct effect remained significant ($c' = 0.619$, $p < 0.001$), and the two-facet model produced a similar pattern. Accordingly, the mediation evidence was considered inconclusive. PPEB was primarily associated directly with Service Quality, while the indirect role of satisfaction could not be established. Harman's single-factor test explained 69.0% of the variance, suggesting substantial potential common-method variance, although the test is not definitive [29], excluding 15 invariant-response cases did not materially alter the results.

G. Operational Records and Their Comparability

Operational Efficiency received high ratings from tenants ($M = 4.46$) and managers ($M = 4.49$). The POS system digitally records transactions and automatically calculates revenue-sharing fees. In January 2026, it recorded sales of IDR 37,634,000 with daily and tenant-level details unavailable under the coupon system. Table 7 and Figure 2 compare the sales records. The 2025 average covers seven months, whereas the 2026 average covers five months; records for June–September 2025 were unavailable, and February 2025 contained no transactions. Average monthly sales were lower after implementation, with consistent declines across all six tenants (Wilcoxon $W = 0$, $n = 6$, $p = 0.031$).

Table 7. Average Monthly Sales before and after POS Implementation

Tenant	2025 (IDR)	2026 (IDR)	Change
Tenant 1	10,996,500	2,569,610	-76.6%
Tenant 2	7,698,286	5,374,800	-30.2%
Tenant 3	8,391,286	7,715,200	-8.1%
Tenant 4	2,585,714	935,000	-63.8%
Tenant 5	941,571	439,600	-53.3%
Tenant 6	11,591,143	7,880,200	-32.0%
All six tenants	42,204,500	24,914,410	-41.0%

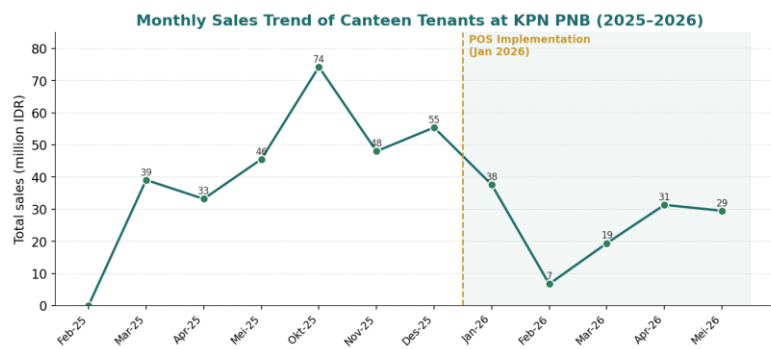


Figure 2. Monthly sales trend of KPN PNB canteen tenants, 2025-2026

This comparison cannot establish the effect of the POS system because the 2025 coupon records and 2026 POS records used different measurement bases. The data were also incomplete, unbalanced, and limited to a five-month post-implementation period, preventing adequate control for seasonality. Although measurement differences may partly explain the decline, this remains unverified; therefore, no operational-efficiency claim is derived from these records.

H. Perceived Paperless Environmental Benefit

PPEB received high ratings from service recipients ($M = 4.23$), tenants ($M = 4.18$), and managers ($M = 4.54$). Based on the 2026 monthly sales average and an assumed transaction value of IDR 15,000, approximately 16,610 coupon slips may have been avoided annually across six tenants. However, this estimate is illustrative because the transaction value was unverified and only half of the tenants were included. As actual paper consumption, unit costs, and accounting recognition were unavailable, the result represents a perceived environmental benefit rather than formal green accounting.

I. Discussion

Perceptions were generally consistent across the three stakeholder groups, supporting a favourable assessment of implementation under the DeLone and McLean framework [1], [16] and extending its application to the cooperative context [17], [18], [23]. However, managers rated Information Quality highest, whereas tenants rated System Quality lowest, consistent with findings in academic information systems [17]. Customer Satisfaction did not mediate the relationship between Service Quality and Perceived Paperless Environmental Benefit. The high intercorrelations among constructs and the 69.0% single-factor result suggest that respondents may have expressed a general evaluation rather than distinct judgements. Alternatively, the removal of paper coupons may have been perceived directly as part of service quality. Clarifying these possibilities requires temporally separated measures, marker variables, or behavioural indicators. The findings imply that perceptual net-benefit extensions should not assume mediation when variables are measured simultaneously. Practical priorities include improving network stability, managerial dashboards, tenant sales histories, automatic journaling, and physical paper-consumption records. Limitations include accidental sampling, small tenant and manager groups, a single cross-sectional case, potential common-method variance [29], non-comparable operational records, and the unvalidated PPEB scale.

5. Conclusions

This study evaluated a centralized retail POS system at KPN PNB using the DeLone and McLean model and examined PPEB as an additional net-benefit dimension. Service Quality was strongly associated with Customer Satisfaction ($\beta = 0.830$; $R^2 = 0.689$) and PPEB ($\beta = 0.834$). However, mediation evidence was inconclusive because the satisfaction pathway was not significant under HC3 estimation, and the bootstrap interval included zero. These findings indicate associations rather than causal effects. The results are constrained by imprecise reliability estimates for tenants and managers, potential common-method variance, and

incomparable pre- and post-implementation sales records. Consequently, no conclusion regarding operational efficiency can be drawn. The environmental contribution remains perceptual rather than formal green accounting. Future studies should use verified paper-consumption and cost data, comparable longitudinal sales records, improved bias controls, and replication across cooperatives.

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