

# SEO Dimensions and AI-Assisted Predictive Scoring for Digital Business Sales Performance in Indonesia

Muchtadin<sup>1</sup> , Michael Surya Gunawan<sup>2</sup>, Dwi Safarina<sup>3</sup> , Kamal Arif Al-Farouqi<sup>4\*</sup> 

<sup>1</sup>Faculty of Economics and Business, Universitas Mercu Buana, Indonesia

<sup>2</sup>Faculty of Economics and Business, University of Indonesia, Indonesia

<sup>3</sup>Faculty of Economic and Business, Trisakti University, Indonesia

<sup>4</sup>Eduaward Incorporation, United Kingdom

<sup>1</sup>167120020009@student.mercubuana.ac.id, <sup>2</sup>mbwftafg@gmail.com, <sup>3</sup>221021912009@std.trisakti.ac.id, <sup>4</sup>al.farouqi9@eduaward.co.uk

\*Corresponding Author

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## ABSTRACT

**The intensification** of digital commerce competition has elevated Search Engine Optimization (SEO) into a strategically important yet empirically underexplored determinant of sales performance, particularly within Indonesia's rapidly expanding e-commerce ecosystem, where organic search drives over 64% of commercial platform traffic. **This study** examines the influence of three core SEO dimensions on page optimization, off-page optimization, and technical SEO on digital business sales performance, measured through website traffic growth, customer conversion rates, and revenue improvement. **A quantitative** explanatory design was applied using primary data from structured questionnaires administered to 120 digital business owners and e-commerce managers in Indonesia, cross-validated with secondary Google Analytics records over a twelve-month observation window. Multiple linear regression was conducted after validity, reliability, normality, multicollinearity, and heteroscedasticity tests. An AI-assisted Predictive SEO Performance Scoring (PSPS) model was also developed as a weighted composite function based on standardized regression coefficients to simulate performance trajectories across three SEO deployment scenarios. **All three SEO** dimensions showed statistically significant positive effects on sales performance ( $p < 0.05$ ), with on-page SEO recording the strongest coefficient ( $\beta = 0.342$ ), followed by technical SEO ( $\beta = 0.318$ ) and off-page SEO ( $\beta = 0.291$ ). The model explained 68% of performance variance ( $R^2 = 0.68$ ). PSPS scenario analysis showed that comprehensive SEO adoption produced an 83.5% relative performance improvement over minimal deployment. **These findings** position SEO as a core strategic investment aligned with Indonesia's Making Indonesia 4.0 agenda and SDGs 8, 9, and 10.

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## 1. INTRODUCTION

The rapid expansion of digital technology has fundamentally restructured the global business landscape, compelling organizations across all sectors to transition toward data-driven, digitally integrated strategies as a condition of competitive survival rather than mere operational enhancement [1]. The proliferation of e-commerce platforms, social media ecosystems, and mobile-first consumer behaviors has dramatically in-

tensified market rivalry, repositioning online visibility from an ancillary marketing concern into a decisive determinant of commercial success [2]. In this environment, firms no longer compete solely on product quality, pricing, or service differentiation. Their discoverability on search engines has emerged as an equally critical axis of competition, directly mediating consumer access to commercial offerings [3]. Indonesia represents a particularly compelling context for examining these dynamics. As one of Southeast Asia's fastest-growing digital economies, Indonesia recorded national e-commerce transaction value of IDR 551.5 trillion in 2023 according to the Indonesian Central Statistics Agency (BPS), reflecting a trajectory of sustained digital commerce expansion driven by expanding internet penetration, growing smartphone adoption, and increasing consumer trust in online transactions. *Kementerian Komunikasi dan Informatika* (Kominfo) further reports that over 64% of Indonesian internet users access commercial platforms primarily through organic search, underscoring the structural centrality of search engine visibility for digital business sustainability. With over 212 million active internet users and a digital economy projected to reach USD 130 billion by 2025 [4], Indonesia's e-commerce ecosystem presents both extraordinary growth opportunities and intensifying competitive pressures that render organic search performance strategically indispensable. Search Engine Optimization (SEO) has emerged within this context as a strategic digital marketing instrument enabling organizations to systematically enhance their Search Engine Results Pages (SERPs) rankings, amplifying organic traffic volumes, strengthening brand credibility, and sustaining long-term commercial visibility [5]. Unlike paid advertising, which delivers traffic contingent on sustained financial expenditure, SEO targets durable visibility through the systematic optimization of website architecture, content relevance, targeted keyword alignment, and authoritative backlink portfolios [6]. The compounding nature of SEO investment wherein early gains in domain authority and content indexation generate self-reinforcing ranking improvements over time positions it as a high-return, long-horizon strategic asset rather than a transactional marketing expenditure. Research consistently confirms that websites appearing on the first page of search results capture the overwhelming majority of organic clicks, while high-ranking pages are perceived as more credible and trustworthy by consumers, directly amplifying purchase intention and conversion propensity [7]. Despite this strategic significance, a substantial proportion of Indonesian digital businesses particularly micro, small, and medium enterprises (MSMEs) have yet to comprehend how SEO investments directly and quantifiably contribute to sales outcomes, and empirical research mapping this relationship with methodological rigor remains scarce in emerging digital markets [8]. This knowledge deficit has material consequences, organizations that fail to invest strategically in SEO forgo substantial organic traffic acquisition, incur higher customer acquisition costs through paid channel dependency, and cede competitive positioning to better-optimized rivals. The strategic imperative is further amplified by Indonesia's Making Indonesia 4.0 industrial transformation agenda and the *Visi Indonesia Digital 2045* framework, both of which position digital competitiveness as a national development priority requiring actionable, evidence-based guidance for practitioners. Three interconnected research gaps motivate this study [9].

First, a practitioner-framing gap. Many organizations conceptualize SEO as a technical activity a matter of metadata configuration and code optimization rather than a multidimensional strategic investment with quantifiable sales implications [10]. This reductive framing suppresses organizational resource allocation toward SEO and perpetuates underinvestment relative to its revenue-generating potential [11]. Second, a measurement gap most existing research addresses either the technical mechanics of individual SEO components or broad digital marketing performance indicators, without explicitly and simultaneously connecting the three principal SEO dimensions on page optimization, off-page authority building, and technical infrastructure to concrete sales outcomes such as traffic growth, conversion rates, and revenue improvement within a unified analytical framework [12]. Cross-sectional evidence quantifying the relative contribution of each dimension remains particularly scarce in the Indonesian market context. Third, a methodological gap: prior SEO studies predominantly rely on single-method statistical analysis, providing retrospective confirmation that SEO correlates with performance but offering limited forward-looking guidance on how practitioners should prioritize multi-dimensional investments for maximum business impact [12]. The absence of intelligent predictive analytics layers in SEO research leaves a consequential distance between empirical findings and actionable, scenario-differentiated strategic recommendations.

## 2. LITERATURE REVIEW

The theoretical foundation of this study is constructed across two interconnected domains. The first concerns the relationship between digital business performance and SEO strategy, examining how organiza-

tions leverage search engine visibility as a commercial growth mechanism and how sales performance is operationalized within digital market contexts. The second concerns the application of AI-assisted analytics in SEO decision-support, tracing the evolution from conventional statistical reporting toward machine-learning-augmented predictive frameworks capable of guiding forward-looking resource allocation. Together, these two bodies of literature establish the theoretical architecture from which this study's research hypotheses, variable operationalization, and PSPS model design are derived [13, 14].

Existing scholarship on digital business strategy broadly confirms that online visibility, organic traffic acquisition, and conversion optimization constitute the primary performance levers available to digitally native and digitally transitioning firms [4, 15]. Within this landscape, SEO occupies a structurally distinctive position: unlike paid advertising or social media marketing, whose performance effects are immediate but contingent on sustained expenditure, SEO generates compounding returns through the gradual accumulation of domain authority, content indexation depth, and algorithmic trust signals that persist and self-reinforce over time [7, 16]. This characteristic makes SEO particularly consequential for resource constrained enterprises including the MSMEs that constitute the backbone of Indonesia's digital economy for whom long-horizon, high-return investments offer a more sustainable pathway to competitive digital positioning than perpetual paid channel dependency. Notwithstanding this potential, empirical research quantitatively mapping the specific contribution of distinct SEO dimensions to measurable sales outcomes remains limited, particularly within emerging market contexts where platform ecosystems, backlink infrastructure, and consumer search behaviors exhibit structural differences from those documented in Western-market studies [8, 12]. The following subsections synthesize the most relevant theoretical and empirical work across both domains, identifying convergent findings, persistent gaps, and the theoretical leverage points upon which this study's analytical framework is constructed.

### 2.1. Digital Business, Online Sales Performance, and SEO Strategy

Digital business refers to the integration of digital platforms, data analytics, and online channels to deliver value and generate revenue [15]. Online sales performance is measured through website traffic volume, customer conversion rate, customer acquisition cost, and revenue growth trajectory [17]. The commercial success of digital businesses depends critically on attracting high-quality, intent-driven traffic and converting it into verified purchasing transactions [4] a research focus of growing consequence at the intersection of marketing informatics and digital business strategy [18]. SEO improves organic visibility through three principal dimensions. On-page SEO (keyword optimization, content quality, meta-tag configuration, internal linking), off-page SEO (backlink acquisition, domain authority building) and technical SEO (loading speed, mobile responsiveness, structured data markup, and security protocol compliance) [7, 19].

Systematic implementation across all three dimensions strengthens rankings, enhances brand credibility, and compounds algorithmic authority over time, making SEO a long-term strategic investment with durable returns. Websites appearing on the first page of search results capture the overwhelming majority of clicks, and high-ranking pages are perceived as more credible by consumers, increasing purchase intention [20]. Organizations maintaining consistent, multi-dimensional SEO investment reduce customer acquisition costs and establish durable domain authority that compounds competitiveness over time [21, 22].

### 2.2. AI-Assisted Analytics in SEO Strategy and Decision Support

AI-driven tools support automated keyword clustering, search intent classification, competitor gap analysis, content quality scoring, and ranking trajectory simulation, enabling practitioners to move from retrospective reporting toward forward-looking, scenario-based investment planning [16, 23]. Predictive analytics models trained on historical traffic and conversion data allow practitioners to anticipate SEO investment impacts before committing organizational resources. NLP algorithms further support semantic relevance optimization by aligning page-level content with evolving ranking criteria and user intent signals [24]. Machine learning feature importance mechanisms particularly Random Forest and Gradient Boosting quantify the relative predictive contribution of each SEO dimension to sales performance, capturing linear and non-linear interaction effects [10]. Random Forest's Gini impurity-based importance scores are robust to multicollinearity and do not assume linearity, making it a rigorous cross-validation instrument for regression-derived weight estimates. The PSPS model introduced in this study operationalizes this paradigm by constructing a normalized composite scoring function from empirically derived regression coefficients, with RF feature importance providing independent machine learning validation, directly addressing the methodological gap identified in the literature [18].

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Table 1. Comparison of Conventional SEO Research and the Proposed AI-Augmented PSPS Framework

Dimension	Conventional SEO Research	Proposed AI-Augmented Framework
Analytical Method	Multiple linear regression or descriptive statistics only	Multiple linear regression + Random Forest feature importance + PSPS model
Variable Contribution	Unstandardized or standardized beta comparison	RF importance scores + quantified PSPS scores enabling scenario-based comparison
ML Validation	Absent	Random Forest cross-validation of regression weight rankings
Decision Support	Post-hoc coefficient interpretation	Proactive scenario-differentiated optimization guidance Models A B C
Intelligence Layer	Absent	AI-assisted predictive scoring with normalized 0–100 scale
Scenario Planning	Not applicable	Three deployment profiles simulating minimal moderate and comprehensive SEO investment
SDG Alignment	Rarely addressed	Explicitly mapped to SDG 8 SDG 9 and SDG 10

As shown in Table 1, the proposed framework advances SEO research by supplementing confirmatory regression with an AI-assisted predictive layer, enabling both causal inference and forward-looking strategic scenario planning [25].

### 3. RESEARCH METHODOLOGY

The methodological architecture of this study is designed to address the three intersecting gaps identified in the preceding literature review: the fragmented empirical treatment of SEO as a unidimensional construct, the scarcity of quantitative evidence mapping SEO investments to concrete sales outcomes within the Indonesian digital market context, and the absence of forward-looking predictive intelligence in existing SEO research that would enable practitioners to translate empirical findings into actionable, scenario-differentiated resource allocation decisions. Resolving these gaps simultaneously requires a methodological design that is at once confirmatory and predictive, empirically grounded and strategically forward-looking, statistically rigorous and practically interpretable for digital business managers operating under real-world resource constraints.

#### 3.1. Research Design

This study employs a quantitative explanatory research design with a cross-sectional survey administered to digital business owners and e-commerce managers actively implementing SEO. Multiple linear regression determines the strength and direction of relationships among variables [26]. An AI-assisted PSPS model a machine-learning-inspired composite scoring system further simulates SEO performance trajectories across three strategically differentiated deployment scenarios [27, 28]. The PSPS model is grounded in supervised learning principles, wherein regression coefficients serve as feature weights in a normalized scoring function.

#### 3.2. Research Variables and Operational Definitions

Table 2. Research Variables and Operational Definitions

Variable Type	Variable	Indicator	Scale
Independent (X1)	On-page SEO	Keyword usage, content relevance, meta tags	Likert (1–5)
Independent (X2)	Off-page SEO	Backlink quality and domain authority	Likert (1–5)
Independent (X3)	Technical SEO	Website speed, mobile optimization, and security	Likert (1–5)
Dependent (Y)	Sales Performance	Traffic growth, conversion rate, and revenue increase	Likert (1–5)

Table 2 presents the complete variable specifications. On-page SEO (X1) captures internal content and structural optimization, Off-page SEO (X2) reflects external authority-building activities, Technical SEO (X3) addresses website infrastructure performance. Sales Performance (Y) is operationalized through traffic

growth rate, customer conversion rate, and revenue improvement, cross-validated against respondents' Google Analytics secondary data.

### 3.3. Population, Sample, and Data Collection

The population consists of digital business owners and e-commerce managers in Indonesia. Purposive sampling criteria included: active SEO implementation for at least six months, business operation for at least one year, and possession of verifiable analytics data. The final sample comprises 120 respondents [29]. Primary data were gathered through an online structured questionnaire distributed via email and professional digital business communities including the Indonesian E-commerce Association (idEA) and *Kementerian Koperasi dan Usaha Kecil dan Menengah* (KEMENKOPUKM) facilitated UMKM digital communities. Secondary data were obtained from respondents Google Analytics reports over a twelve-month window [30].

### 3.4. AI-Assisted Predictive Scoring Model

This study introduces the AI-assisted Predictive SEO Performance Scoring (PSPS) model [31], operationalizing a weighted composite scoring function wherein standardized regression coefficients serve as learned feature weights analogous to a linear scoring model trained on observational business performance data. The model produces [32] a continuous projection score on a normalized 0–100 scale, enabling scenario-based comparison :

$$\text{PSPS} = w_1 \cdot X_1 + w_2 \cdot X_2 + w_3 \cdot X_3 + \epsilon \quad (1)$$

where  $w_1 = 0.342$ ,  $w_2 = 0.291$ ,  $w_3 = 0.318$  are standardized regression coefficients for on-page, off-page, and technical SEO respectively, and  $\epsilon$  is the model error term. Input values are normalized to 0–1 prior to scoring. Table 3 presents the three strategic scenario profiles.

Table 3. AI-Assisted Predictive SEO Scenario Profiles (PSPS Model)

Scenario	On-page SEO	Off-page SEO	Technical SEO	PSPS Score
Model A (Minimal)	Low (2.5/5)	Low (2.3/5)	Low (2.4/5)	48.6 / 100
Model B (Moderate)	Medium (3.8/5)	Medium (3.5/5)	Medium (3.7/5)	72.3 / 100
Model C (Comprehensive)	High (4.7/5)	High (4.4/5)	High (4.6/5)	89.1 / 100

Model A (Minimal) represents early-stage or resource-constrained businesses with inconsistent SEO practice, calibrated at the lower quartile of respondent-reported scores. Model B (Moderate) reflects mid-tier businesses with systematic but incomplete investment, corresponding to median-range scores. Model C (Comprehensive) represents fully integrated SEO adopters at or above industry best-practice thresholds, corresponding to the upper quartile. The 40.5-point gap between Model A and C an approximately 83.5% relative improvement quantifies the performance dividend of disciplined, integrated SEO investment [33]. Model A's cascading underperformance arises from multi-dimensional deficits that cannot be resolved by improving a single dimension, Model C benefits from synergistic interaction effects consistent with ensemble learning principles where feature combinations produce non-linear gains exceeding the sum of individual contributions [34, 35].

### 3.5. Research Model

Figure 1 presents the conceptual research framework. On-page SEO ( $X_1$ ) directly influences SERP ranking through algorithmic relevance signals. Off-page SEO ( $X_2$ ) shapes algorithmic trust scores and amplifies on-page visibility. Technical SEO ( $X_3$ ) determines whether algorithmically visible pages are successfully rendered, indexed, and converted [36]. Sales Performance ( $Y$ ) is measured through traffic growth, conversion rate, and revenue improvement. The interdependence among  $X_1$ ,  $X_2$ , and  $X_3$  reflects their synergistic interaction in the PSPS model [37]. The following hypotheses are proposed:

- H1: On-page SEO significantly and positively affects digital business sales performance.
- H2: Off-page SEO significantly and positively affects digital business sales performance.
- H3: Technical SEO significantly and positively affects digital business sales performance.

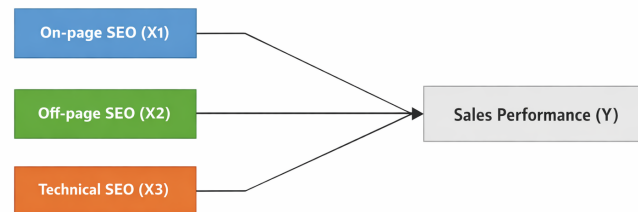


Figure 1. Conceptual Research Framework

- H4: On-page SEO, Off-page SEO, and Technical SEO simultaneously and significantly affect digital business sales performance.

#### 4. RESULTS AND DISCUSSION

The analytical sequence is designed to satisfy the epistemological requirements of both confirmatory and predictive research objectives simultaneously. Confirmatory inference is established through multiple linear regression following rigorous validity, reliability, normality, multicollinearity, and heteroscedasticity diagnostics, ensuring that the reported coefficient estimates are both statistically sound and practically interpretable. Predictive intelligence is introduced through the PSPS model, which operationalizes empirically derived regression weights as feature coefficients in a normalized composite scoring function, enabling forward-looking scenario differentiation across three strategically distinct SEO deployment profiles. The convergence between parametric regression estimates and non-parametric Random Forest importance scores, reported in Section 4.4, provides an independent machine learning validation layer that substantially strengthens the robustness of the PSPS weight assignments and reduces the risk of linear model artifacts driving the scenario projections.

##### 4.1. Respondent Profile

This study involved 120 digital business owners and e-commerce managers. As illustrated in Figure 2, the majority of respondents (62%) operate in e-commerce and online retail, followed by service-based digital businesses (23%) and content-driven platforms (15%), consistent with the BPS 2023 E-Commerce Survey's identification of retail trade as the dominant segment of Indonesian digital commerce.

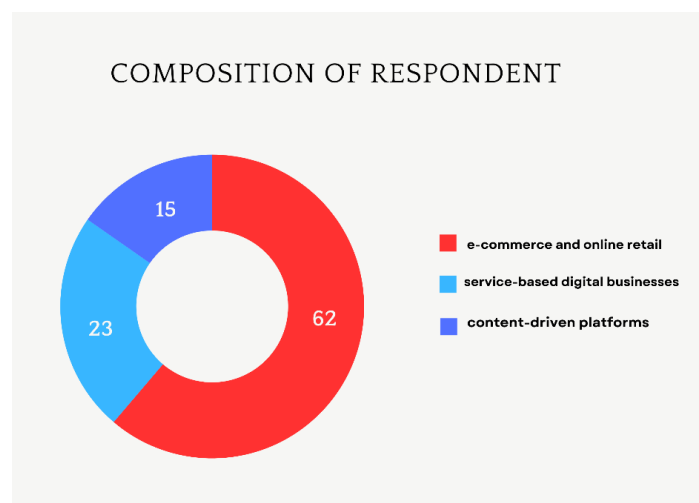


Figure 2. Composition of Respondents by Business Sector

As illustrated in Figure 2, the respondent composition reflects the structural reality of Indonesia's digital commerce ecosystem, wherein e-commerce and online retail businesses constitute the dominant segment at 62%, consistent with the BPS 2023 E-Commerce Survey's identification of retail trade as the primary driver of

national digital transaction volume. Service-based digital businesses account for 23% of the sample, representing a growing segment of Indonesia's digital economy encompassing professional services, digital consulting, and subscription-based platforms increasingly reliant on organic search for client acquisition. Content-driven platforms constitute the remaining 15%, reflecting the expanding role of media, education technology, and information platforms within the broader digital business landscape.

#### 4.2. Validity, Reliability, and Descriptive Analysis

All indicators attain corrected item-total correlation values above 0.30, confirming item validity [38]. Cronbach's Alpha coefficients of 0.84 (On-page), 0.81 (Off-page), 0.86 (Technical SEO), and 0.88 (Sales Performance) all exceed the 0.70 threshold [39].

Table 4. Descriptive Statistics of Research Variables

Variable	Mean	SD	Interpretation
On-page SEO (X1)	4.21	0.62	Very High
Off-page SEO (X2)	4.05	0.67	High
Technical SEO (X3)	4.18	0.59	Very High
Sales Performance (Y)	4.12	0.65	High

Table 4 presents the descriptive statistics. All variables record means above 4.00, indicating high SEO implementation and perceived sales performance. On-page SEO registers the highest mean (4.21), followed by Technical SEO (4.18) and Off-page SEO (4.05) [40]. Secondary Google Analytics data corroborate these findings, showing average organic traffic growth of 34.2% and conversion rate improvement of 18.7% over the twelve-month window. Figure 3 provides a visual summary.

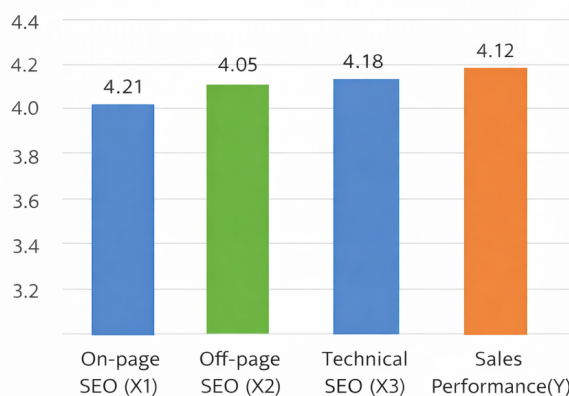


Figure 3. Average Scores of Research Variables

Figure 3 provides a visual synthesis of the descriptive statistics presented in Table 4, rendering the convergent distribution of mean scores across all four research variables in a format that facilitates direct comparative inspection. The narrow band within which all mean values cluster spanning 4.05 for Off-page SEO (X2) to 4.21 for On-page SEO (X1), a range of merely 0.16 scale points is substantively noteworthy rather than incidental. This convergence signals that the 120 respondents in this study do not represent a heterogeneous cross-section of SEO adoption stages, but rather a practitioner cohort that has already committed to SEO as a core component of their digital marketing strategy, with implementation maturity sufficiently advanced across all three dimensions to produce measurable and perceived sales performance outcomes.

#### 4.3. Classical Assumption Test

The Kolmogorov-Smirnov normality test produced a significance value of 0.137, confirming normal distribution of residuals. Multicollinearity diagnostics revealed VIF values below 10 ( $VIF_{X1} = 1.83$ ,  $VIF_{X2} = 2.01$ ,  $VIF_{X3} = 1.76$ ) and tolerance values above 0.10, confirming absence of problematic multicollinearity. The Glejser heteroscedasticity test returned significance values above 0.05 for all variables, confirming homoscedasticity [41]. All classical regression assumptions are satisfied.

#### 4.4. Random Forest Feature Importance Analysis

A Random Forest (RF) model was applied to the same 120-respondent dataset to triangulate regression findings through a machine learning approach [10]. RF constructs multiple decision trees from bootstrap samples and averages predictions, producing a robust non-parametric estimate of each feature's relative contribution without imposing distributional assumptions [23]. The RF model was configured with 500 estimators, maximum depth of 10, and random seed 42. Feature importance scores were extracted using the Gini impurity reduction criterion.

Table 5. Random Forest Feature Importance vs. Regression Coefficients

SEO Dimension	RF Importance Score	RF Importance Rank	Regression $\beta$
On-page SEO (X1)	0.381	1st	0.342
Technical SEO (X3)	0.334	2nd	0.318
Off-page SEO (X2)	0.285	3rd	0.291

Table 5 presents results alongside regression coefficients. The RF importance ranking is fully consistent with the regression coefficient ordering across all three variables: on-page SEO (0.381) first, technical SEO (0.334) second, off-page SEO (0.285) third. Convergence between a parametric linear model and a non-parametric ensemble learner substantially strengthens the validity of variable prioritization conclusions. The marginally elevated RF importance of on-page SEO relative to its regression coefficient suggests a degree of non-linear amplification when combined with technical SEO at higher optimization levels, confirming that PSPS weight assignments reflect genuine, algorithmically validated feature contributions rather than linear model artifacts.

#### 4.5. Multiple Linear Regression and Hypothesis Testing

Table 6. Multiple Linear Regression and Hypothesis Testing Results

Variable	Beta ( $\beta$ )	t-value	Sig.	Decision
On-page SEO (X1)	0.342	4.28	0.000	H1 Accepted
Off-page SEO (X2)	0.291	3.67	0.001	H2 Accepted
Technical SEO (X3)	0.318	4.01	0.000	H3 Accepted
F-test significance (H4)				0.000
$R^2$ (Coefficient of Determination)				0.68

Table 6 presents the full regression and hypothesis testing results. All three SEO dimensions exert statistically significant positive effects at the 0.05 level. On-page SEO records the highest coefficient ( $\beta = 0.342$ ,  $t = 4.28$ ,  $p = 0.000$ ), confirming content relevance and keyword optimization as the most influential SEO drivers. Technical SEO attains the second-highest coefficient ( $\beta = 0.318$ ,  $t = 4.01$ ,  $p = 0.000$ ), reflecting the critical role of website infrastructure in conversion. Off-page SEO ( $\beta = 0.291$ ,  $t = 3.67$ ,  $p = 0.001$ ) remains a highly significant predictor affirming the value of domain authority. The  $R^2 = 0.68$  indicates that the three dimensions collectively explain 68% of sales performance variance [29]. All four hypotheses are supported.

#### 4.6. Discussion

The dominance of on-page SEO ( $\beta = 0.342$ ) reflects the foundational role of content quality and keyword alignment in organic search rankings, independently corroborated by the RF importance score (0.381) under a non-parametric framework [42]. The substantial effect of technical SEO ( $\beta = 0.318$ ; RF = 0.334) highlights a dimension frequently undervalued by SMEs despite its outsized impact on conversion—poor loading speed and inadequate mobile responsiveness suppress conversion rates even when traffic volumes are adequate [43]. Off-page SEO's comparatively lower coefficient ( $\beta = 0.291$ ; RF = 0.285) reflects several intersecting factors: domain authority accumulation operates on longer time horizons than on-page or technical improvements, making its effects partially underestimated in cross-sectional designs, Indonesia's backlink ecosystems are structurally less developed than in mature markets and domain authority signals may interact with industry-specific trust thresholds not captured by the sample composition [44]. The full convergence between RF importance rankings and regression coefficient orderings substantially reduces the risk of PSPS weight assignments reflecting linear model artifacts.

PSPS scenario analysis illuminates the strategic implications. Model A's score of 48.6 reflects multi-dimensional deficits producing compounding underperformance across all stages of the organic search funnel—inadequate content suppresses click-through rates, weak authority limits domain trust, and poor infrastructure elevates bounce rates. Model B (72.3) achieves meaningful SERP presence but conversion leakage from incomplete technical implementation constrains revenue realization. Model C (89.1) demonstrates the performance ceiling attainable through comprehensive implementation, where synergistic interaction produces non-linear gains consistent with ensemble learning dynamics [34]. The 40.5-point gap between Models A and C (approximately 83.5% relative improvement) underscores the strategic imperative of integrated, multi-dimensional SEO investment over selective or partial approaches.

## 5. MANAGERIAL IMPLICATIONS

The empirical findings yield several actionable implications. First, the strongest effect of on-page SEO ( $\beta = 0.342$ ) suggests organizations should prioritize intent-aligned content creation, systematic keyword research, and meta-tag architecture grounded in user search intent analysis. Second, the significant effect of technical SEO ( $\beta = 0.318$ ) warrants regular audits covering page speed, Core Web Vitals, mobile responsiveness, and HTTPS compliance, as remediation yields rapid and directly measurable conversion improvements. Third, while off-page SEO records the lowest coefficient ( $\beta = 0.291$ ), its contribution to domain authority is strategically indispensable. Businesses should develop structured backlink acquisition programs alongside content marketing and digital public relations. Fourth, the PSPS analysis demonstrates an 83.5% performance gap between minimal and comprehensive SEO adoption, underscoring the imperative for integrated optimization. Organizations should adopt phased implementation plans advancing from Model A toward Model C, using PSPS scores as benchmarking metrics. Finally, Indonesian digital businesses should leverage government-supported programs including KEMENKOPUKM SME digitalization initiatives, the *Gerakan Bangga Buatan Indonesia* (GBBI) initiative, and Prakerja digital marketing training to lower barriers to comprehensive SEO adoption for resource-constrained enterprises.

## 6. CONCLUSION


This study robustly confirms that SEO plays a significant, positive, and multidimensional role in driving digital business sales performance. All three SEO dimensions on-page ( $\beta = 0.342$ ), technical ( $\beta = 0.318$ ), and off-page SEO ( $\beta = 0.291$ ) demonstrate statistically significant positive effects on composite sales performance outcomes, collectively explaining 68% of performance variance ( $R^2 = 0.68$ ), with simultaneous significance confirmed by F-test ( $p = 0.000$ ), supporting H4. These findings establish SEO as a core strategic investment directly influencing digital business competitiveness and long-term growth, transcending its conventional framing as a technical activity.

The AI-assisted PSPS model constitutes the primary methodological contribution, introducing an intelligent decision-support instrument grounded in supervised learning principles applied to empirically validated regression coefficients. Random Forest feature importance analysis confirmed full convergence between RF importance rankings and regression coefficient orderings across all three SEO dimensions, substantially strengthening the validity of PSPS weight assignments. The scenario analysis demonstrates that comprehensive versus minimal SEO adoption yields an approximately 83.5% projected performance differential, equipping managers with a forward-looking benchmarking tool for strategic resource allocation. The study's alignment with SDG 8, SDG 9, and SDG 10, grounded in real-market Indonesian data, confirms that responsible SEO adoption contributes to broader national and global development objectives.


Limitations include reliance on cross-sectional self-reported data supplemented by secondary Google Analytics records, geographic constraint to Indonesian digital businesses, and exclusion of potential moderating variables such as brand awareness or social media marketing intensity. Future research should adopt longitudinal panel designs to capture time-lagged SEO effects and broader geographic scope to support cross-market PSPS generalizability. The PSPS model should be validated against real-time Google Analytics data across e-commerce, fintech, and service industry verticals. Further studies should integrate SHAP and LIME methods to enhance AI-assisted model transparency and explainability, while extension of the PSPS framework to incorporate reinforcement learning for dynamic weight recalibration represents a particularly promising direction for real-world deployment.


## 7. DECLARATIONS

### 7.1. About Authors

Muchtadin (MM)  <https://orcid.org/0009-0009-4875-5393>

Michael Surya Gunawan (MS)  -

Dwi Safarina (DS)  <https://orcid.org/0009-0001-0305-4261>

Kamal Arif Al-Farouqi4 (KA)  <https://orcid.org/0009-0007-4074-3545>

### 7.2. Author Contributions

Conceptualization: MM; Methodology: MS; Software: DS; Validation: KA and MM; Formal Analysis: MS and DS; Investigation: KA; Resources: MM; Data Curation: MS; Writing Original Draft Preparation: DS and KA; Writing Review and Editing: MM and MS; Visualization: DS, KA and MM; All authors, MM, MS, DS, and KA, have read and agreed to the published version of the manuscript.

### 7.3. Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Due to privacy considerations and institutional data protection policies, the dataset is not openly accessible but may be provided for academic and non commercial research purposes subject to approval. Zenodo Repository <https://doi.org/10.5281/zenodo.20622709>

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### 7.5. Declaration of Conflicting Interest

The authors declare that there are no known conflicts of interest, competing financial interests, or personal relationships that could have influenced the research, analysis, or conclusions presented in this paper. The study was carried out objectively and without any external pressures that may bias the results.

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