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Artificial Intelligence Utilization in Digital Marketing Processes of Indonesian Vocational Training Institutions An Integrated TOE and Delphi Approach

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Abstract

This study examines the utilization of Artificial Intelligence (AI) in digital marketing processes among Vocational Training Institutions (Lembaga Pelatihan Kerja/LPK) in Indonesia, a non-formal education sector characterized by limited human resources, infrastructure, and policy support. Using a sequential explanatory mixed-methods design, quantitative data from 96 LPKs were analyzed through Structural Equation Modeling Partial Least Squares (SEM-PLS) based on the Technology-Organization-Environment (TOE) framework, followed by a three-round Delphi method involving four experts representing the AI, digital marketing, LPK management, and government sectors. The results show that environmental factors, namely policy support, funding, and collaboration, significantly influence both AI utilization and digital marketing effectiveness, whereas technological and organizational factors show no significant direct effect. AI utilization itself positively and significantly affects digital marketing effectiveness and fully mediates the relationship between environmental factors and marketing outcomes. The Delphi panel affirmed that government policy, funding, and human resource digital literacy are the most critical enablers for AI-driven transformation. These findings indicate that successful AI adoption in LPKs depends more on external environmental support than on internal technological or organizational readiness, offering practical implications for policymakers, LPK managers, and technology providers seeking to accelerate AI adoption and strengthen vocational training effectiveness in Indonesia.

Keywords: Artificial Intelligence, Digital Marketing, Vocational Training Institution, TOE Framework, Mixed Method.

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INTRODUCTION

The rapid advancement of Artificial Intelligence (AI) is reshaping digital marketing paradigms across industries, enhancing customer engagement, personalization, and operational efficiency as global adoption accelerates (HubSpot, 2025). Within Indonesia's non-formal education sector, however, particularly among Vocational Training Institutions (Lembaga Pelatihan Kerja/LPK), AI adoption remains nascent. LPKs face distinct constraints, including limited digital literacy, budgetary pressure, and inadequate infrastructure, which are compounded by the high proportion of non-accredited institutions operating in the sector (Kementerian Ketenagakerjaan RI, n.d.).

The Technology-Organization-Environment (TOE) framework has been widely used to explain technology adoption, but its application has been concentrated in corporate, e-commerce, and higher-education settings (Alghafitri & Khalid, 2019; Widodo et al., 2024). Studies conducted on large firms or formal universities may not capture the realities of LPKs, which are typically small-scale, resource-constrained, and oriented toward workforce development rather than academic research. While the benefits of AI in marketing are well documented (Mishra et al., 2022;

Kaur et al., 2022), including its capacity to streamline consumer interaction and content creation through tools such as chatbots and generative content engines (Ngai et al., 2021), most of this evidence originates from large corporations or generic business-to-consumer contexts (Kamkankaew, 2024). Smaller training institutions in developing economies often recognize AI's potential yet struggle to translate that awareness into implementation because of limited digital infrastructure and human capital (Rodriguez et al., 2024).

Research applying TOE to formal higher-education contexts tends to find organizational readiness and environmental pressure as key determinants (Alimboyong & Bucjan, 2022; Widodo et al., 2024), but these findings may not transfer directly to LPKs, whose informal structures and acute resource limitations differ substantially from universities. In a related developing-country context, environmental and organizational factors were found to dominate technological considerations in explaining ICT-adoption barriers (Ergado et al., 2021), suggesting that TOE factors may need to be recalibrated when applied to similarly resource-constrained institutions. Despite growing literature at the intersection of AI-enabled marketing and technology-adoption theory, empirical studies that apply the TOE framework specifically to AI adoption for digital marketing within the LPK ecosystem remain scarce; prior work in adjacent contexts has largely relied on theoretical discussion or single-method designs (Rif'an, 2024; Elkhatibi & Benabdelouhed, 2024), and recent studies on AI adoption in education continue to focus on formal higher-education institutions with substantially different resource profiles (Suradi et al., 2024; Rahmawati et al., 2023).

A preliminary survey of 120 LPKs conducted for this study found that 57% of respondents had only a moderate understanding of AI in digital marketing, 29% possessed basic knowledge, and 9% had no understanding at all. This digital-literacy gap, together with a high non-accreditation rate of 80–82% over 2024–2025, illustrates the structural barriers LPKs face in adopting new technology and underscores the need for a systematic evaluation of AI implementation tailored to this sector.

This study addresses that gap by investigating the antecedent factors that drive AI utilization in LPKs' digital marketing and by assessing the resulting impact on marketing effectiveness. Three research questions guide the study: (1) what is the level and pattern of AI utilization in LPKs' digital marketing; (2) what are the key drivers and barriers to AI adoption; and (3) how does AI utilization affect digital marketing effectiveness? A mixed-methods approach combining a TOE-grounded quantitative survey with qualitative expert consensus through the Delphi method is employed to provide a context-specific evaluation.

The study offers two main contributions. Theoretically, it extends the TOE framework to a non-formal education context, testing its applicability while revealing sector-specific factor dynamics. Practically, it offers evidence-based, consensus-driven strategies for LPK managers, policymakers, and training networks to accelerate AI-enabled digital transformation, supporting broader workforce-development goals within Indonesia's digital economy agenda and contributing to SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth).

METHOD

This study employed an explanatory sequential mixed-methods design (Creswell & Clark, 2017), combining a quantitative phase testing relationships among TOE factors, AI utilization, and digital marketing effectiveness with a qualitative Delphi phase that validated and elaborated on the quantitative findings.

The research model was built on the TOE framework (Tornatzky & Fleischer, 1990), positing that Technological Factors (ease of use, compatibility, relative advantage), Organizational Factors (management support, HR competency, technological resources), and Environmental Factors (competitive pressure, regulatory pressure, customer needs) influence AI Utilization, which in turn affects Digital Marketing Effectiveness and mediates the relationship between the three TOE dimensions and this outcome. Seven hypotheses were tested: AI Utilization significantly affects Digital Marketing Effectiveness (H1); Technological (H2), Organizational (H3), and Environmental (H4) factors each significantly affect AI Utilization; and AI Utilization mediates the effect of Technological (H5), Organizational (H6), and Environmental (H7) factors on Digital Marketing Effectiveness.

The quantitative instrument was a structured questionnaire built from validated TOE indicators (Alghafitri & Khalid, 2019; Widodo et al., 2024; Alimboyong & Bucjan, 2022) using a 5-

point Likert scale. The target population comprised active LPKs that had operated for at least two years and used digital platforms for marketing. Using purposive sampling, questionnaires were distributed to 120 LPKs through the HILLSI (Himpunan Lembaga Pelatihan Seluruh Indonesia) network, yielding 96 valid responses—well above the minimum of 55 required under the Slovin formula at a 10% margin of error, and adequate for SEM-PLS analysis (Hair et al., 2022). Data were analyzed with SmartPLS 3.2.9 in two stages: measurement-model evaluation (Cronbach's Alpha and Composite Reliability > 0.7; Average Variance Extracted > 0.5; Fornell–Larcker discriminant validity) and structural-model testing via bootstrapping with 5,000 resamples to obtain path coefficients, t-statistics, p-values, and R^2.

The qualitative phase applied a Ranking-Type Delphi method over three rounds with four purposively selected experts: an AI engineer affiliated with the AI Community of Indonesia (AICO), a digital-marketing lecturer, the Secretary General of HILLSI, and a staff expert at the Ministry of Manpower. Round 1 gathered open-ended input on critical success factors; Round 2 asked experts to rank five synthesized strategic factors from most (5 points) to least important (1 point); and Round 3 computed the Interquartile Range (IQR) for each factor to assess consensus, with IQR ≤ 1 taken as the threshold for agreement (Alwi et al., 2019). Quantitative and qualitative findings were then triangulated through a convergent parallel design to generate actionable strategic recommendations.

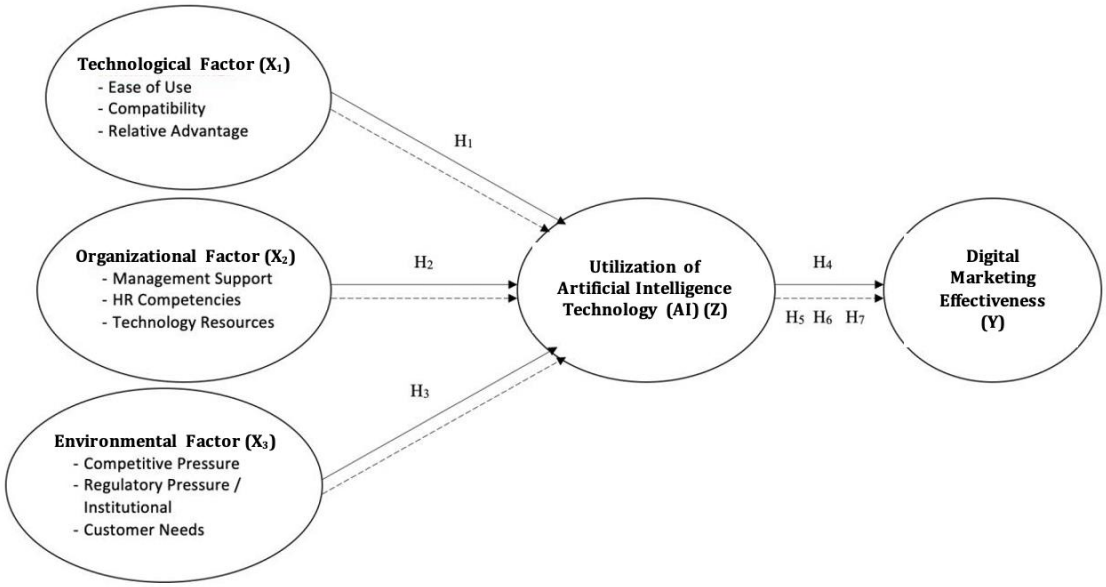


Figure 1. Research Model and Hypotheses Development

RESULT AND DISCUSSION

Respondents were predominantly institution leaders (43%), followed by marketing managers (30%) and marketing staff (21%). Most respondents (47%) were aged 31–40 years, and 54% had more than five years of LPK experience. All 96 participating LPKs were private institutions spanning 13 provinces, with the highest concentration in Central Java (47%); 61% were accredited and 39% were not. Detailed respondent and institutional characteristics are summarized in Table 1.

Table 1. Respondent and Vocational Training Institution (LPK) Profile

Characteristic	Category	Frequency	Percentage
LPK Experience	1-3 years	24	25%
	3-5 years	20	21%
	>5 years	52	54%
Accreditation	Accredited	59	61%
	Not Accredited	37	39%

Survey data show that 71% of LPKs (68 institutions) currently employ AI in their marketing activities, while 29% (28 institutions) have not yet adopted it. Among adopters, AI is

used most for content generation, such as automated text, image, and design production (71 instances), followed by advertising automation on social media and Google (41 instances), sentiment analysis (35 instances), chatbot services (25 instances), recommendation systems for program matching (19 instances), and content personalization (15 instances). Usage intensity varies: 57% use AI several times weekly, 29% rarely, and only 14% daily. Social media dominates as the primary AI application channel (58%), while 26% of LPKs report no specific platform focus, indicating largely ad hoc rather than strategic implementation. The leading objectives for AI adoption are accelerating content creation (39%) and improving response speed to prospective participants (23%), and responsibility for AI operations is most often held by internal digital-marketing teams (26%), with 15% of LPKs lacking dedicated personnel altogether.

The measurement model demonstrated satisfactory reliability and validity across all constructs. As shown in Table 2, every construct exceeded the recommended thresholds for internal consistency (Cronbach's Alpha and Composite Reliability > 0.7), and convergent validity (AVE > 0.5), and discriminant validity was confirmed through the Fornell–Larcker criterion.

Table 2. Measurement Model Assessment Results

Construct	Cronbach's Alpha	Composite Reliability	AVE
Technological Factors (X1)	0.814	0.871	0.517
Organizational Factors (X2)	0.945	0.956	0.761
Environmental Factors (X3)	0.925	0.941	0.707
AI Utilization (Z)	0.969	0.973	0.804
Digital Marketing Effectiveness (Y)	0.966	0.972	0.806

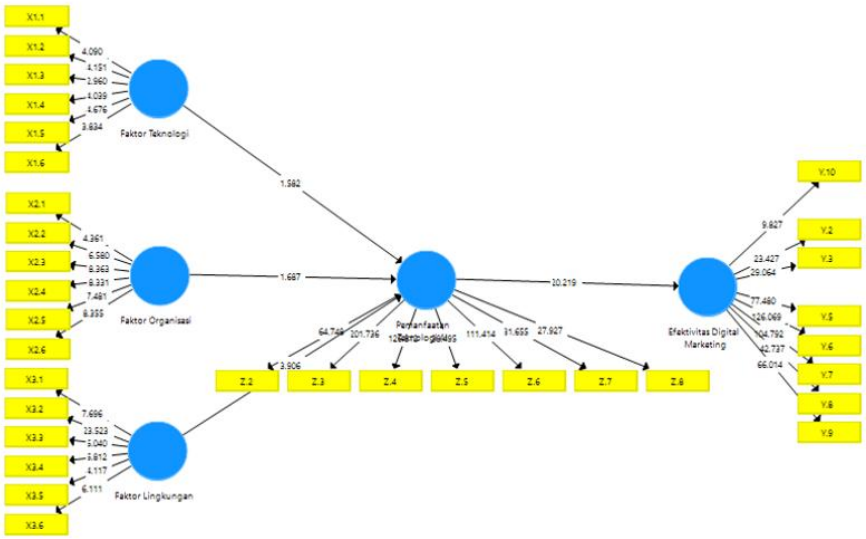


Figure 2. Structural Model with Path Coefficients and Significance Level

Structural-model testing revealed that Environmental Factors significantly and positively influenced AI Utilization (H4: β=0.401, p<0.001), explaining 40.1% of its variance, while AI Utilization significantly affected Digital Marketing Effectiveness (H1: β=0.496, p<0.001), with the full model explaining 45.1% of the variance in that outcome. Full mediation was confirmed only for the path from Environmental Factors through AI Utilization to Digital Marketing Effectiveness (H7: β=0.199, p<0.001). Neither Technological Factors (H2: β=0.105, p=0.092) nor Organizational Factors (H3: β=0.091, p=0.114) had a significant direct effect on AI Utilization, and their indirect effects (H5, H6) were likewise non-significant. Full hypothesis-testing results are presented in Table 3.

Table 3. Hypothesis Testing Results

Hypothesis	Path	β	t-stat	p-value	Decision
H1	AI Utilization → Marketing Effectiveness	0.496	3.906	0.000	Supported
H2	Technological	0.105	1.687	0.092	Not Supported

	Factors → AI Utilization				
H3	Organizational Factors → AI Utilization	0.091	1.582	0.114	Not Supported
H4	Environmental Factors → AI Utilization	0.401	20.219	0.000	Supported
H5	Technological Factors → AI Utilization → Marketing Effectiveness	0.052	1.536	0.124	Not Supported
H6	Organizational Factors → AI Utilization → Marketing Effectiveness	0.045	1.628	0.103	Not Supported
H7	Environmental Factors → AI Utilization → Marketing Effectiveness	0.199	3.785	0.000	Supported

The three-round Delphi process produced a ranked set of strategic factors for AI implementation in LPK digital marketing (Table 4). Experts unanimously placed policy support and government funding first (mean score 4.25), yet no factor reached strong consensus (IQR ≤ 1), reflecting the heterogeneity of LPK contexts across Indonesia's regions. During the exploratory round, panelists identified funding as the primary barrier, since AI tools, training, and infrastructure require investment beyond most LPKs' capacity; human-resource digital literacy as a fundamental constraint; the absence of a clear regulatory and data-protection framework as a source of uncertainty; and collaboration with technology providers, universities, and other institutions as essential for knowledge transfer.

Table 4. Delphi Consensus on Strategic Factors

Rank	Strategic Factor	Mean Score	Final IQR	Consensus
1	Policy Support and Government Funding	4.25	2.0	Moderate
2	HR Strengthening and Digital Literacy	3.25	4.0	Low
3	Collaboration with Industry and Academia	2.75	2.0	Moderate
4	AI-Based Digital Marketing System Integration	2.50	3.0	Low
5	Technology Infrastructure and Data Development	2.25	2.0	Moderate

The dominance of environmental factors over technological and organizational readiness is consistent with institutional theory, which emphasizes external pressures and normative frameworks in shaping organizational behavior (Scott, 2014). For LPKs operating at early stages of digital maturity, the perceived ease of use of AI tools or internal management capability becomes secondary when foundational environmental support—government mandates, funding programs, regulatory clarity, and partnership opportunities—is absent. This pattern diverges from TOE findings in corporate settings (Kajla et al., 2023) but aligns with studies of resource-constrained educational institutions, where environmental and organizational pressures dominate technological considerations (Ergado et al., 2021).

The non-significant effects of technological and organizational factors can be explained in three complementary ways. First, technological characteristics such as ease of use or compatibility matter little when institutions lack basic prerequisites, such as reliable internet access or funds to

subscribe to AI platforms. Second, organizational readiness—management support and HR competency—becomes meaningful only within an enabling environment; committed leadership alone cannot overcome systemic barriers such as absent training infrastructure or regulatory uncertainty. Third, the LPK sector's small scale and simple organizational structures likely make internal dynamics less influential than external ecosystem conditions, consistent with evidence on the implementation challenges faced by small training institutions (Rodriguez et al., 2024).

The confirmed full mediation of Environmental Factors through AI Utilization (H7) indicates that supportive policy or subsidies alone are insufficient; they must translate into actual AI deployment and integration into marketing workflows to affect outcomes. This suggests that policy interventions should be evaluated not merely on availability but on accessibility and effectiveness in driving real adoption, underscoring the need for implementation-support mechanisms such as technical assistance, training, and mentorship.

The Delphi results reinforce and extend these quantitative findings. The prioritization of policy and funding, followed by human-resource development, suggests a sequential pathway: establishing enabling conditions, building capacity, facilitating collaboration, enabling technical integration, and developing infrastructure. The moderate-to-low consensus on implementation specifics (factors 2–5) indicates that a one-size-fits-all approach is inappropriate, and that tiered or adaptive strategies accommodating institutional heterogeneity are needed—an insight that complements and enriches the quantitative evidence.

Theoretically, these findings extend the TOE framework's application to non-formal vocational education and suggest that, in resource-constrained settings, environmental factors may function as prerequisites rather than co-equal determinants alongside technological and organizational readiness. Practically, the results provide evidence-based guidance for several stakeholder groups. Policymakers, particularly within the Ministry of Manpower, should prioritize supportive regulatory environments, targeted financial assistance, and industry-academia-LPK partnerships. LPK managers should actively engage available support programs while simultaneously strengthening internal digital literacy and innovation-oriented culture. Technology providers can contribute by developing affordable, contextually appropriate AI solutions accompanied by adequate training support.

CONCLUSION

This study demonstrates that AI adoption in digital marketing within Indonesian Vocational Training Institutions is predominantly driven by external environmental factors, with AI utilization serving as a critical mediator that positively affects marketing effectiveness, while internal technological and organizational readiness are not primary differentiators at the sector's current stage of development. The integration of SEM-PLS analysis with Delphi expert consensus validates the TOE framework's applicability in non-formal educational contexts and shows that environmental factors, particularly policy support, government funding, and collaborative ecosystems, are essential prerequisites for AI adoption; only once these conditions are established can technological features and organizational capacities meaningfully contribute to implementation success. For policymakers, particularly at the Ministry of Manpower and related agencies, these findings support the development of comprehensive programs such as AI-tool subsidies, digital-marketing training grants, clear data-governance guidelines, and facilitated industry-academia-LPK partnerships designed for accessibility and practical usability across diverse LPK contexts. For LPK managers and practitioners, the strategic priority is to proactively engage available support mechanisms while building internal digital literacy and fostering a culture of innovation, with collaboration among peers, industry, and educational institutions accelerating knowledge transfer and resource access. Future research should employ longitudinal designs to track adoption dynamics over time, broaden geographic and institutional diversity in sampling, and examine which specific policy mechanisms and partnership models are most effective in sustaining AI integration across Indonesia's vocational training sector.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

The data associated with this study are available in: Ardyani, A. W. (2026). Evaluating the Utilization of Artificial Intelligence Technology in Digital Marketing [Data set]. Zenodo. https://doi.org/10.5281/zenodo.18197965

AUTHOR CONTRIBUTIONS

Amalia Widya Ardyani: Conceptualization, Methodology, Investigation, Formal Analysis, Writing - Original Draft, Writing - Review & Editing. **Viany Utami Tjhin**: Supervision, Methodology, Validation, Writing - Review & Editing. All authors have read and agreed to the published version of the manuscript.

INFORMED CONSENT

Informed consent was obtained from all survey and Delphi participants involved in the study.

REFERENCES

Abbasi, M., Nishat, R. I., Bond, C., Graham-Knight, J. B., Lasserre, P., Lucet, Y., & Najjaran, H. (2024). A review of AI and machine learning contribution in business process management (process enhancement and process improvement approaches). *Business Process Management Journal*. https://doi.org/10.1108/bpmj-07-2024-0555

Adenuga, A. A., Gaffar, O., Sikiru, A. O., & Otunba, M. (2023). Current State of AI Adoption in the SME Sector and the Barriers that Hinder Widespread Implementation. *Shodhshauryam, International Scientific Refereed Research Journal, 6*(4), 423-440. https://doi.org/10.32628/SHISRRJ

Aggarwal, C. C. (2020). *Recommender systems: The textbook*. Springer International Publishing.https://www.springer.com/gp/book/9783319296579

Aladayleh. (2020). A framework for integration of artificial intelligence into digital marketing in jordanian commercial banks.. journal of innovations in digital marketing, 1(1), 32-39. https://doi.org/10.51300/jidm-2020-10

Alenezi, M., Wardat, S., & Akour, M. (2023). The Need of Integrating Digital Education in Higher Education: Challenges and Opportunities. *Sustainability*, *15*(6), 4782. https://doi.org/10.3390/su15064782

Alghatrifi, I. ., & Khalid, H. . (2019). Factors Affecting Emerging Technology Adoption in Higher Education: A Systematic Mapping Study. *Open International Journal of Informatics*, *7*(Special Issue 1), 147–157. Retrieved from https://oiji.utm.my/index.php/oiji/article/view/126

Alshohaib, K. A. (2024). From screens to carts: the role of emotional advertising appeals in shaping consumer intention to repurchase in the era of online shopping in post-pandemic. *Frontiers in Communication*, *9*. https://doi.org/10.3389/fcomm.2024.1370545

Alimboyong, C. R., & Bucjan, M. E. (2022). Cloud Computing adoption among state universities and colleges in the Phillippies Issues and Challenges: A Toe Framework Analysis. *International Journal of Educational Research and Evaluation, 11(3), 45-62. https://doi.org/10.11591/ijere.v11i3.21526*

Alwi, A., Kamis, A. ., Moreno Herrera, L. ., Luis Yturria Motenegro, P. ., Mat Nashir, I., Che Kob, C. G., & Tze Kiong, T. (2019). Modified Delphi Technique in Analysing Contents of Green Skills Module for Design and Technology Subject. *Journal of Technical Education and Training*, *12*(1). https://publisher.uthm.edu.my/ojs/index.php/JTET/article/view/3194

Belinda, B. (2025). Peran artificial intelligence dalam digital marketing dan perilaku konsumen Indonesia. *Jurnal GICI*. https://journal.stiegici.ac.id/index.php/jurnal-gici/article/download/391/1023/2083

Brodeur, J., Pellerin, R., & Deschamps, I. (2022). Operationalization of Critical Success Factors to Manage the Industry 4.0 Transformation of Manufacturing SMEs. *Sustainability*, *14*(14), 8954. https://doi.org/10.3390/su14148954

Cao, L. (2022). AutoAI: Autonomous AI. *IEEE Intelligent Systems*, *37*(5), 3–5. https://doi.org/10.1109/mis.2022.3209046

Chishti, M. Z., Xia, X., & Dogan, E. (2024). Understanding the effects of artificial intelligence on energy transition: The moderating role of Paris Agreement. *Energy Economics, 131*, 107388. https://doi.org/10.1016/j.eneco.2024.107388

de Freitas, M. P., Piai, V. A., Farias, R. H., Fernandes, A. M. da R., Rossetto, A. G. de M., & Leithardt, V. R. Q. (2022). Artificial Intelligence of Things Applied to Assistive Technology: A Systematic Literature Review. *Sensors*, *22*(21), 8531. https://doi.org/10.3390/s22218531

Dong, J., Yu, Y., Zhang, Y., Lv, Y., Wang, S., Jin, B., Wang, Y., Wang, X., & Wang, D. M. (2023). A Deep Behavior Path Matching Network for Click-Through Rate Prediction. *The Web Conference*. https://doi.org/10.1145/3543873.3584662

Elkhatibi & Benabdelouhed.(2024). Digital marketing and artificial intelligence: towards a better understanding of the two strategies. IJAMRS, 4(3), 755-760. https://doi.org/10.62225/2583049x.2024.4.3.2847

Ergado, A. A., Desta, A., & Mehta, H. (2021). Determining the barriers contributing to ICT implementation by using technology-organization-environment framework in Ethiopian higher educational institutions. *Education and Information Technologies*, *26*(3), 3115–3133. https://doi.org/10.1007/S10639-020-10397-9

Esteve-Mon, F. M., Postigo-Fuentes, A. Y., & Castañeda, L. (2022). A strategic approach of the crucial elements for the implementation of digital tools and processes in higher education. *Higher Education Quarterly*. https://doi.org/10.1111/hequ.12411

Fabac, R. (2022). Digital Balanced Scorecard System as a Supporting Strategy for Digital Transformation. *Sustainability*, *14*(15), 9690. https://doi.org/10.3390/su14159690

Fitzpatrick, J. L., Sanders, J. R., & Worthen, B. R. (2024). Program evaluation: Alternative approaches and practical guidelines (5th ed.). Pearson.

Fornari, F., Compagnucci, I., Callisto De Donato, M., Bertrand, Y., Beyel, H. H., Carrión, E., Franceschetti, M., Groher, W., Grüger, J., Kilic, E., Koschmider, A., Leotta, F., Li, C.-Y., Lugaresi, G., Malburg, L., Mangler, J., Mecella, M., Pastor, Ó., Riss, U. V., … Valderas, P. (2024). *Digital Twins of Business Processes: A Research Manifesto*.https://doi.org/10.48550/arxiv.2410.08219

Funa, A. A., & Talaugon, A. M. (2025). Policy guidelines and recommendations on AI integration in education. *Computers and Education: Artificial Intelligence, 6*, Article 100218. https://doi.org/10.1016/j.caeai.2024.100418

Ghozali, I., & Latan, H. (2021). *Partial least squares: Konsep, metode dan aplikasi dengan program SmartPLS 3*. Universitas Diponegoro. https://www.statistikian.com/2021/04/inner-model-pls-sem-smart-pls.html

Green, R. A. (2014). The Delphi Technique in Educational Research. *SAGE Open*, *4*(2), 2158244014529773. https://doi.org/10.1177/2158244014529773

Haenlein, M., Kaplan, A. M., Tan, C.-W., & Zhang, P. (2019). *Artificial intelligence (AI) and management analytics*. *6*(4), 341–343. https://doi.org/10.1080/23270012.2019.1699876

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). SagePublications.https://www.smartpls.com/documentation/algorithms-and-techniques/pls/

HubSpot. (2025). HubSpot's 2025 AI trends for marketers report. https://offers.hubspot.com/ai-marketing

IAB Europe. (n.d.). *Programmatic advertising*. IAB Europe Glossary. Retrieved November 23, 2024, from https://iabeurope.eu/glossary/programmatic-advertising

Irawan, S. P. (2024). Analisis kesiapan digital mahasiswa PGSD dalam menghadapi era industri 4.0. *Jurnal Pendidikan Ummul Qura*, 8(2), 120-135.https://journal.ummat.ac.id/index.php/ecs/article/download/32841/pdf

Johnson, N. F., Purwanegara, M. S., & Mulyono, N. B. (2024). Enhancing E-Commerce with Big Data: From Browsing to Buying Through Recommendation Systems. *International Journal of Entrepreneurship, Business, and Creative Economy*, *4*(1), 130–145. https://doi.org/10.31098/ijebce.v4i1.1930

Jung, S.-U., & Shegai, V. (2023). The Impact of Digital Marketing Innovation on Firm Performance: Mediation by Marketing Capability and Moderation by Firm Size. *Sustainability*, *15*(7), 5711. https://doi.org/10.3390/su15075711

Kajla, T., Sood, K., Gupta, S., Raj, S., & Singh, H. (2023). *Identification and prioritization ofthe factors influencing blockchain adoption in the banking sector: integrating fuzzy AHP with TOE framework*. https://doi.org/10.1108/ijqrm-03-2023-0079

Kamis, A., Moreno Herrera, L., Yturria Montenegro, P. L., Alwi, A., Mat Nashir, I., Che Kob, C. G., & Tze Kiong, T. (2020). Modified Delphi technique in analysing contents of green skills module for design and technology subject. *Journal of Technical Education and Training, 12*(1), 49–56. http://www.diva-portal.org/smash/record.jsf?pid=diva2:1429073

Kamkankaew. (2024). How artificial intelligence is helping businesses grow and thrive: the transformative role of artificial intelligence in thai b2c digital marketing. IJSASR, 4(1), 137-164. https://doi.org/10.60027/ijsasr.2024.3651

Kaur, R., Singh, R., Gehlot, A., Priyadarshi, N., & Twala, B. (2022). Marketing Strategies 4.0: Recent Trends and Technologies in Marketing. *Sustainability*, *14*(24), 16356. https://doi.org/10.3390/su142416356

Kementerian Ketenagakerjaan RI. (n.d.). *Jumlah Lembaga Pelatihan Kerja (LPK).* Satudata Kemnaker. Dikutip [20 Juni 2025] dari https://satudata.kemnaker.go.id/data/kumpulan-data/2421

Kementerian Ketenagakerjaan Republik Indonesia. (2025). *Pelatihan digital marketing berbasis artificial intelligence*. P3N Kemnaker. https://p3n.kemnaker.go.id/front/detail_pelatihan/ffe6965d-44a0-4b63-83f1-be4adf186802

Khaw, K. W., et al. (2025). Unveiling the antecedents of green information systems practices for sustainability. *The Electronic Journal of Information Systems in Developing Countries, 91*(4). https://doi.org/10.1002/isd2.70015

Korzyński, P., Costa e Silva, S., Górska, A. M., & Mazurek, G. (2024). Trust in AI and top management support in generative-AI adoption. Journal of Computer Information Systems.Advance online publication. https://doi.org/10.1080/08874417.2024.2401986

Kumar, V., Ashraf, A. R., & Nadeem, W. (2024). AI-powered marketing: What, where, and how? International Journal of Information Management, 77, 102783. https://doi.org/10.1016/j.ijinfomgt.2024.102783

Kotler, P., Kartajaya, H., & Setiawan, I. (2021). *Marketing 5.0: Technology for humanity*. John Wiley & Sons.

Lahadalia, B. (2025). *Disertasi: Analisis tekanan kompetitif dan adopsi teknologi* [Disertasi doktoral, Universitas]. https://id.scribd.com/document/781321306/Disertasi-Bahlil-Lahadalia-Sidang-Promosi-Final

Liu, B. (2012). *Sentiment analysis and opinion mining*. Synthesis Lectures on Human Language Technologies, 5(1), 1–167. Morgan & Claypool Publishers. https://doi.org/10.2200/S00416ED1V01Y201204HLT016

Lu, X., Wijayaratna, K., Huang, Y., & Qiu, A. A. (2022). AI-Enabled Opportunities and Transformation Challenges for SMEs in the Post-pandemic Era: A Review and Research Agenda. *Frontiers in Public Health*, *10*. https://doi.org/10.3389/fpubh.2022.885067

Marrucci, A., Rialti, R., & Balzano, M. (2023). Exploring paths underlying Industry 4.0 implementation in manufacturing SMEs: a fuzzy-set qualitative comparative analysis. *Management Decision*. https://doi.org/10.1108/md-05-2022-0644

McKinsey & Company. (2023, *January* 19). *What is generative AI?* McKinsey Explainers.https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-generative-ai

Menta, A. J. (2022). Adopting Technology Environment Organization Framework in Virtual Learning through Cloud Computing of Higher Education Institution. *International Journal of Computing Sciences Research*, *6*, 822–841. https://doi.org/10.25147/ijcsr.2017.001.1.75

Mishra, S., Ewing, M. T., & Cooper, H. (2022). Artificial intelligence focus and firm performance. *Journal of the Academy of Marketing Science*, *50*(6), 1176–1197. https://doi.org/10.1007/s11747-022-00876-5

Mohd Amin, M. R., Asbi, A., Sivakumaran, V. M., Kim, J., & Septiarini, E. (2025). Artificial intelligence (AI) adoption in marketing strategies: Navigating the present and shaping the future business landscape. Social Sciences & Humanities Open, 12, 102048. https://doi.org/10.1016/j.ssaho.2025.102048

Muhyi, H. A., Chan, A., Herawaty, T., Sukamadewi, R., & Kahfi, A. A. (2024). Organizational Readiness for Artificial Intelligence with Systematic Mapping Study in Public and Private Sectors. *Sosiohumaniora: Jurnal Ilmu-Ilmu Sosial dan Humaniora, 26*(3), 483-494. https://doi.org/10.24198/sosiohumaniora.v26i3.56493

Mukhtar, N., et al. (2020). Conceptual model of technical sustainability for integration into electrical/electronic engineering programmes in Nigerian polytechnics. *IEEE Access, 8*, 128519–128535. https://doi.org/10.1109/ACCESS.2020.3002579

Ngai et al. "An intelligent knowledge-based chatbot for customer service" Electronic commerce research and applications (2021) https://doi.org/10.1016/j.elerap.2021.101098

Ngabalin, A. M. (2025). The Impact of Artificial Intelligence on Operational Efficiency in Marketing Management. *Asian Journal of Applied Business and Management*, *4*(2), 545–554. https://doi.org/10.55927/ajabm.v4i2.223

Ningrum, D. K. (2025). Analisis kepuasan pengguna terhadap peran kecerdasan buatan dalam layanan chatbot VIRA MyBCA. *Jurnal Ilmiah Teknik Elektro Telekomunikasi, 6*(1), 1-12.

Novantara, P. (2024). Pemanfaatan AI Ads untuk digital marketing produk UMKM. *Jurnal Informatika dan Sistem Ekonomi*. https://jise.uniku.ac.id/pub/article/download/96/45/363

OECD (2023). OECD Framework for the Evaluation of Public Policies. OECD Publishing, Paris. https://doi.org/10.1787/603183c4-en

Olbrich, S., Pöppelbuß, J., & Niehaves, B. (2012). Critical contextual success factors for business intelligence: A Delphi study on their relevance, variability, and controllability. In *Proceedings of the Annual Hawaii International Conference on System Sciences* (pp. 4148–4157). https://doi.org/10.1109/HICSS.2012.187

Osman, N. M., & Yaakub, K. B. B. (2022). Trust school standards and practices measurement instrument: Validity and reliability. *International Journal of Academic Research in Business and Social Sciences, 12*(1). https://doi.org/10.6007/IJARBSS/v12-i1/12354

Putra, J. (2023). Analisis kepuasan pengguna pada e-learning menggunakan metode End User Computing Satisfaction. *Jurnal Sisfokom, volume*(issue), 1-12. https://jurnal.atmaluhur.ac.id/index.php/sisfokom/article/view/1575

Prasetyo, R. J., & Andrilla, R. (2025). Balikpapan Micro, Small, and Medium Enterprises (MSMES) and Artificial Intelligence Adoption: TOE Framework. *Journal Geoekonomi, 16*(01), 11-20. https://doi.org/10.36277/geoekonomi.v16i1.540

Rahadi, R. A., Wiryono, S. K., Nainggolan, Y. A., Afgani, K. F., Yaman, R., Azmi, A. S. M., Ismail, F. Z., Saputra, J., Rahmawati, D., & Moulynia, A. (2022). Determining the factors influencing residential property price: A comparative study between Indonesia and Malaysia. *Decision Science Letters, 11*(4), 485–496. https://doi.org/10.5267/j.dsl.2022.6.002

Ramdan, M. (2025). Job training as a pillar of workforce development: government efforts to enhance labor competitiveness. *Eksekusi: Journal Of Law*, *7*(1), 70. https://doi.org/10.24014/je.v7i1.37315

Rana, J., & Daultani, Y. (2022). Mapping the Role and Impact of Artificial Intelligence and Machine Learning Applications in Supply Chain Digital Transformation: A Bibliometric Analysis. *Operations Management Research*, 1–26. https://doi.org/10.1007/s12063-022-00335-y

Rangel-de Lázaro, G., & Duart, J. M. (2023). You Can Handle, You Can Teach It: Systematic Review on the Use of Extended Reality and Artificial Intelligence Technologies for Online Higher Education. *Sustainability*, *15*(4), 3507. https://doi.org/10.3390/su15043507

Rif'an .(2024). The convergence of artificial intelligence and digital marketing. proceeding of the international seminar on business economics social science and technology (ISBEST), 4(1). https://doi.org/10.33830/isbest.v4i1.3266

Rodriguez, A., Fernandez, B., Lopez, C., & Garcia, M. (2024). Generative AI adn re-waving a pedagogical horizon of social possibility. International Journal of Educational Technology in Higher Education. https://doi.org/10.1186/s41239-024-00445-6

Speed, C., & Metwally, A. A. (2025). The Human-AI Hybrid Delphi Model: A Structured Framework for Context-Rich, Expert Consensus in Complex Domains.*arXiv.Org*,*abs/2508.09349*.https://doi.org/10.48550/arxiv.2508.09349

Sarstedt, M., Hair, J.F., & Ringle, C.M. (2021). *PLS-SEM: Indeed a Silver Bullet*. Journal of Marketing Theory and Practice.

Sakas, D. P., Reklitis, D., Terzi, M. C., & Vassilakis, C. (2022). Multichannel Digital Marketing Optimizations through Big Data Analytics in the Tourism and Hospitality Industry. *Journal of*

Theoretical and Applied Electronic Commerce Research, *17*(4), 1383–1408. https://doi.org/10.3390/jtaer17040070

Sánchez, E., Calderón, R., & Herrera, F. (2025). Artificial intelligence adoption in SMEs: Survey based on TOE–DOI framework, primary methodology and challenges. Applied Sciences, 15(12), 6465. https://doi.org/10.3390/app15126465

Schweidel, D. A., Bart, Y. Y., Inman, J. J., Stephen, A. T., Libai, B., Andrews, M., Rosario, A. B., Chae, I., Chen, Z., Kupor, D., Longoni, C., & Thomaz, F. (2022). How consumer digital signals are reshaping the customer journey. *Journal of the Academy of Marketing Science*, *50*(6), 1257–1276. https://doi.org/10.1007/s11747-022-00839-w

Setiawan, H. (2025). Sistem informasi pendataan peserta lembaga pelatihan kerja pada Dinas Tenaga Kerja Kabupaten Asahan. *Jurnal Uranus*, 5(1), 20–30.

Henn, S., & Bagheri, S. (2024). *Critical success factors for business intelligence across BI maturity levels in startups*. In Proceedings of the European Conference on Information Systems (ECIS 2024). https://aisel.aisnet.org/ecis2024/track07_busanalytics/track07_busanalytics/15/

Humphrey-Murto, S., Wood, T. J., Gonsalves, C., Mascioli, K., & Varpio, L. (2020). The Delphi method. *Academic Medicine, 95*(1), 168. https://doi.org/10.1097/ACM.0000000000002887

Stahl, B. C., Antoniou, J., Bhalla, N., Brooks, L., Jansen, P., Lindqvist, B., Kirichenko, A., Marchal, S., Rodrigues, R. E., Lugo Santiago, N., Warso, Z., & Wright, D. (2023). A systematic review of artificial intelligence impact assessments. *Artificial Intelligence Review*, 1–33. https://doi.org/10.1007/s10462-023-10420-8

Suchita, N. B., Lay, E., Kristina, D., Angelin, M., Prestille, M., & Celline, H. L. (2025). Penggunaan artificial intelligence (AI) dalam membangun bisnis berkelanjutan dan meningkatkan loyalitas konsumen di era persaingan global. *Jurnal Uvers, 5*(1), 39–51. https://journal.uvers.ac.id/index.php/fbr/article/download/283/249/1597

Suprihartini, Purwoko, P., Widyatmike, G. M., Nurlaili, N., & Masrur, Y. (2025). Digital Promotion Strategies Utilizing Social Media to Improve the Image of Educational Institutions. *Journal of Educational Management Research*, *4*(3), 1010–1022. https://doi.org/10.61987/jemr.v4i3.1055

Suradi, N. R. M., Kahar, S., Jamaludin, N. A. A., Aziz, A. A., Arbain, M. N. R., Ramli, A. R., NAR, N. N., & Handan, R. (2024). Validating a Web-based Academic Application's Quality Model at Malaysian Public Universities: A Delphi Study. *Pakistan Journal of Life and Social Sciences*, *22*(1). https://doi.org/10.57239/pjlss-2024-22.1.0090

Syahidun., Susetyono, E., Adiwijaya, A., Madani, M., & Kareem, Y. M. (2025). AI Adoption Barriers in SMEs Analyzing through the Technology Organization Environment TOE Framework. *APTISI: Transaction on Management, 9*(3), 278-289. DOI: 10.33050

Widodo, D. S., Rachmawati, D., Wijaya, H., Maghfuriyah, A., & Udriya, U. (2024). AI Adoption in Higher Education Institution: An Integrated TAM and TOE Model. *Dinasti International Journal of Education Management and Social Science (DIJEMSS)*, *6*(2), 1029–1039. https://doi.org/10.38035/dijemss.v6i2.3645

Witara, K. (2025). Pengaruh implementasi AI dalam manajemen SDM. *JRIME: Jurnal Riset Manajemen dan Ekonomi*. https://jurnal.itbsemarang.ac.id/index.php/JRIME/article/download/3550/3604/15755

Xu, S. (2024). Exploring the impact of personalization in artificial intelligence on digital marketing: Performance evaluation. *Journal of Innovation and Development, 8*(1), 41–44. https://doi.org/10.54097/tht8d457

Yang, X., Xu, Z., & Xu, J. (2022). Large-scale group Delphi method with heterogeneous decision information and dynamic weights. *Expert Systems with Applications*, *213*, 118782. https://doi.org/10.1016/j.eswa.2022.118782

Yaokumah, W., Omane-Antwi, B. B., & Asante-Offei, K. O. (2022). Critical success factors of strategic information systems planning: A Delphi approach. *Kybernetes*. Advance online publication. https://doi.org/10.1108/K-05-2021-0370