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Digitalization, AI Adoption, and MSME Productivity: An Ibn Khaldunian Perspective

ABSTRACT - Micro, Small, and Medium Enterprises (MSMEs) in Indonesia face persistent challenges in improving labor productivity amid rapid digital transformation and the expansion of artificial intelligence (AI). Although digitalization has increased substantially, its productivity effects remain uneven across provinces and are influenced by institutional, cultural, and religious contexts. Grounded in Ibn Khaldun's concepts of *asabiyyah* and *tadbir al-'umran*, this study examines the relationship between digitalization, AI adoption, and MSME labor productivity while assessing the moderating role of religiosity. The study employs an explanatory quantitative approach using provincial-level panel data during 2020–2023. The primary estimation uses a fixed-effects model with robust standard errors, complemented by exploratory analyses using Double Machine Learning, Causal Forest, and XGBoost. The findings show that digitalization has a positive and significant effect on labor productivity, whereas AI adoption has not yet generated measurable productivity gains. Religiosity marginally weakens the relationship between digitalization and productivity, indicating transitional adaptation frictions within highly normative environments rather than resistance to technology. These findings suggest that sustainable productivity gains depend not only on technological adoption, but also on institutional capacity, ethical governance, and collective learning mechanisms. The study contributes to the digital transformation literature by extending Ibn Khaldun's institutional perspective and offers policy insights for strengthening sustainable MSME digital ecosystems in Indonesia.

ABSTRAK - Digitalisasi, Adopsi AI, dan Produktivitas UMKM: Perspektif Ibn Khaldun. *Usaha Mikro, Kecil, dan Menengah (UMKM) di Indonesia menghadapi tantangan dalam meningkatkan produktivitas tenaga kerja di tengah percepatan transformasi digital dan perkembangan kecerdasan buatan (artificial intelligence/AI). Meskipun digitalisasi berkembang pesat, dampaknya terhadap produktivitas masih berbeda antarprovinsi dan dipengaruhi oleh faktor institusional, budaya, dan religiositas. Berlandaskan konsep asabiyyah dan tadbir al-'umran dari Ibn Khaldun, penelitian ini menganalisis hubungan antara digitalisasi, adopsi AI, dan produktivitas tenaga kerja UMKM serta menguji peran moderasi religiositas. Penelitian menggunakan pendekatan kuantitatif eksplanatori dengan data panel tingkat provinsi selama periode 2020–2023. Estimasi utama dilakukan melalui model fixed effects dengan robust standard errors dan dilengkapi analisis eksploratif menggunakan Double Machine Learning, Causal Forest, dan XGBoost. Hasil penelitian menunjukkan bahwa digitalisasi berpengaruh positif dan signifikan terhadap produktivitas tenaga kerja, sedangkan adopsi AI belum menunjukkan dampak yang signifikan. Religiositas memoderasi hubungan digitalisasi dan produktivitas secara negatif marginal, yang mencerminkan friksi adaptasi dalam lingkungan dengan kohesi normatif tinggi, bukan penolakan terhadap teknologi. Temuan ini menunjukkan bahwa keberhasilan transformasi digital bergantung pada kapasitas kelembagaan, tata kelola etis, dan mekanisme pembelajaran kolektif. Studi ini memperluas perspektif institusional Ibn Khaldun dalam kajian transformasi digital serta memberikan implikasi kebijakan bagi penguatan ekosistem digital UMKM yang berkelanjutan di Indonesia.*

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INTRODUCTION

Digital transformation has become a defining feature of contemporary economic development, reshaping how organizations operate, compete, and sustain productivity. Across both developed and emerging economies, the integration of digital technologies and artificial intelligence (AI) into managerial processes has influenced recruitment systems, performance evaluation, and overall organizational efficiency. In this evolving landscape, the relevance of ethical governance, institutional stability, and human-centered development remains central to ensuring that technological progress translates into sustainable economic outcomes.

Within Islamic intellectual traditions, these dynamics resonate with Ibn Khaldun's (1377) concept of *asabiyyah*, which refers to social cohesion, moral order, and collective strength as foundational elements of civilizational development. From this perspective, economic prosperity is not solely determined by technological advancement, but by the interaction between human labor, ethical governance, and institutional integrity. This framework situates digital transformation within a broader socio-moral system, where organizational progress is closely linked to collective coordination and value-driven leadership.

Despite the rapid diffusion of digital technologies in organizational settings, particularly among Micro, Small, and Medium Enterprises (MSMEs), the outcomes of digitalization remain uneven. Technological adoption does not automatically lead to improved productivity, especially when institutional readiness, cultural context, and managerial capacity vary significantly across regions. In many cases, digital tools coexist with structural constraints that limit their effectiveness in human resource management and organizational performance.

Existing studies generally emphasize the positive role of digital transformation and AI in enhancing operational efficiency, improving workforce management, and expanding market access for MSMEs. In the Indonesian context, MSMEs are recognized as a vital economic sector, contributing approximately 60% of national GDP and absorbing more than 97% of the workforce. Between 2020 and 2024, the sector experienced accelerated digital adoption driven by government initiatives, the COVID-19 pandemic, and increased internet penetration (APJII, 2024; Kemenkop, 2024; Kadin, 2024). By 2024, around 89.4% of MSMEs had adopted digital technologies, although only approximately 41.5% relied on online marketplaces as their primary sales channel (Aulia et al., 2020). However, prior research also indicates persistent disparities in digital utilization, particularly in human resource capabilities, digital literacy, and regional institutional adaptation. From an institutional perspective inspired by Ibn Khaldun, such disparities may reflect differences in *tadbir al-mulk* (institutional governance), which influence how effectively technological change is translated into sustained productivity improvements (Utami et al., 2024).

Nevertheless, little is known about how digital transformation and AI adoption in MSME human resource management interact with institutional cohesion and socio-religious contexts across Indonesian provinces. Previous studies have not adequately addressed how variations in collective values and governance consistency shape the productivity outcomes of digitalization. In particular, the moderating role of religiosity as a socio-institutional factor remains underexplored in empirical analyses of MSME digital transformation.

This study aims to examine digital transformation and artificial intelligence adoption in MSME human resource management in Indonesia, with a focus on their relationship with labor productivity across provinces. Specifically, the study pursues two objectives: (1) to describe patterns of digital and AI adoption in MSME human resource management across Indonesian provinces from 2020 to 2024, including variations associated with cultural and religious contexts; and (2) to analyze the empirical relationship between digitalization, AI-related initiatives, policy consistency, and labor productivity, while assessing the moderating role of religiosity within a provincial fixed-effects framework grounded in Ibn Khaldun's concepts of *asabiyyah* and *tadbir al-'umran*.

Correspondingly, the research addresses the following questions: (1) What patterns of digital and AI adoption in MSME human resource management emerge across Indonesian provinces between 2020 and 2024, and how are they associated with cultural and religious contexts? (2) How do digitalization, AI-related programs, and policy consistency relate to labor productivity, and to what extent does religiosity shape this relationship?

This study contributes theoretically by extending Ibn Khaldun's institutional and civilizational framework into contemporary discussions on digital transformation and human resource productivity. It enriches Islamic economic and management literature by positioning *asabiyyah* and *tadbir al-'umran* as analytical lenses for evaluating technological change beyond conventional efficiency metrics.

Practically, the study provides insights for policymakers and practitioners in designing digital transformation strategies that are not only technologically effective but also institutionally coherent and ethically grounded. Understanding regional variation in adoption and the role of socio-religious context may support more inclusive and context-sensitive policy interventions for MSME development in Indonesia. Methodologically, the study combines provincial fixed-effects panel analysis with exploratory machine learning techniques to capture potential heterogeneity in digital transformation outcomes, while acknowledging constraints related to data structure and model stability.

The remainder of this paper is structured as follows: Section 2 reviews the relevant literature, Section 3 presents the methodology, Section 4 discusses the empirical findings, and Section 5 concludes the study.

LITERATURE REVIEW

Managing human resources in the digital era requires organizations to balance technological efficiency with ethical integrity, cultural coherence, and institutional legitimacy. This balance is particularly relevant for Indonesian Micro, Small, and Medium Enterprises (MSMEs), where digital transformation does not occur in a vacuum but interacts closely with local values, organizational traditions, and collective norms. Within this context, Ibn Khaldun's concept of *asabiyyah*—referring to social cohesion, moral order, and collective discipline—provides a useful analytical lens for understanding how human resource (HR) management can evolve alongside technological change while maintaining ethical and institutional stability.

Digitalization, Artificial Intelligence, and Human Productivity

Digitalization and artificial intelligence (AI) have been widely recognized as important drivers of organizational efficiency, particularly in areas such as recruitment, performance evaluation, and workforce development. Gélinas et al. (2022) find that AI-supported recruitment systems can streamline candidate screening processes and reduce administrative workload. In a similar vein, recent empirical studies suggest that AI adoption contributes to improved employee productivity, greater automation of routine tasks, and more accurate predictive analytics related to turnover and retention (Wu, 2024; Petre, 2025).

Despite these potential benefits, the productivity effects of AI are not uniform across organizational settings. This variation is especially evident among small and medium enterprises, where limited absorptive capacity, resource constraints, and uneven managerial readiness may restrict the effective use of advanced technologies. From an Ibn Khaldunian perspective, technological progress alone is insufficient to ensure sustainable development. Without strong ethical governance and institutional coherence, digitalization may unintentionally intensify inequality, weaken managerial transparency, or create organizational fragmentation. In the context of HR management, this perspective highlights the importance of embedding AI adoption within transparent governance structures, human oversight, and ethical decision-making frameworks aligned with the principles of justice (*'adl*) and balance (*mizan*) (Kamri et al., 2014).

Cultural and Religious Contexts in Digital Transformation

Beyond technical capabilities, cultural and religious environments play an important role in shaping how digital technologies are understood, accepted, and institutionalized within organizations. Prior studies indicate that trust, perceived fairness, social legitimacy, and normative alignment significantly influence employees' acceptance of algorithm-based systems and digital platforms (Zhang, 2024; Wang & Surienty, 2024; Yadav & Nigam, 2025). In Islamic management thought, values such as justice, cooperation, and social responsibility contribute to organizational cultures that emphasize ethical accountability and collective welfare (Irmawati & Jaharuddin, 2024).

Rather than functioning solely as drivers of technological adoption, cultural and religious norms can be understood as institutional filters that shape both the pace and direction of digital transformation. Strong normative cohesion may strengthen organizational trust, discipline, and compliance, yet it may also encourage caution when technological practices appear inconsistent with established moral or social expectations. Insights from linguistic anthropology further support this view, showing that shared symbols, language practices, and cultural narratives play a central role in shaping organizational behavior and meaning-making processes (Duranti, 1997; Foley, 1997). In MSME contexts, digital transformation is therefore influenced not only by technological readiness, but also by the degree of compatibility between innovation and prevailing cultural frameworks. This interpretation aligns with Ibn Khaldun's notion of *umran* (civilizational development), which emphasizes the interconnectedness of material progress and socio-cultural foundations.

Policy Consistency and Institutional Continuity

The sustainability of productivity gains from digitalization is also closely linked to policy stability and institutional consistency. In Indonesia, programs aimed at digital transformation and human resource development often face implementation challenges associated with leadership turnover, shifting policy priorities, and coordination gaps between central and local government levels (Kemenkop, 2024). Such dynamics can weaken the continuity of reform efforts and limit the long-term effectiveness of digital initiatives.

Ibn Khaldun's cyclical theory of governance offers a useful explanation for this pattern. When collective commitment and moral discipline decline, institutional effectiveness tends to weaken, ultimately affecting economic performance and public trust. Within this framework, the principle of *tadbir al-mulk*—referring to just, consistent, and well-coordinated governance—becomes essential for ensuring that technological investments translate into sustained improvements in productivity and institutional performance.

Integrative Framework

Bringing these strands together, this study develops an integrative framework grounded in Ibn Khaldun's institutional perspective, linking three interrelated dimensions of digital transformation in MSMEs. First, digitalization and artificial intelligence represent technological capacities that can enhance HR efficiency and organizational coordination. Second, cultural and religious contexts shape how these technologies are interpreted, accepted, and embedded within organizational practices. Third, policy consistency and institutional stability determine whether the benefits of digital transformation can be sustained over time.

Rather than assuming uniform or linear effects, this framework recognizes that the outcomes of technological change are conditioned by broader socio-institutional environments. Accordingly, digital transformation is conceptualized as part of *tadbir al-'umran*—the governance of human and institutional development within ethical and cultural boundaries—offering a contextualized analytical foundation for examining MSME digitalization in Indonesia during the 2020–2024 period.

METHODOLOGY

Research Design

This study adopts an explanatory quantitative approach using provincial-level panel data from 2020 to 2023. The research investigates the empirical relationship between MSME digitalization, artificial intelligence (AI) exposure, and labor productivity while considering the influence of socio-cultural and religious contexts. A panel data framework is employed to capture variations within provinces across time and to control for unobserved provincial characteristics that may influence productivity outcomes (Wooldridge, 2015).

In addition to conventional econometric analysis, the study incorporates several machine learning techniques in an exploratory capacity to examine robustness and identify potential heterogeneity patterns in the data (Athey & Wager, 2018; Chernozhukov et al., 2022). These

approaches complement the main econometric specification rather than serving as primary identification strategies.

The unit of analysis is the Indonesian province. Initial data compilation covered 12 provinces with complete observations during the 2020–2023 period, producing 48 potential panel observations. However, after integrating all variables, particularly the religiosity index and AI proxy, two provinces exhibited incomplete observations for at least one year. To maintain consistency in estimation and preserve the validity of interaction-term analysis, the final balanced panel consists of 10 provinces observed over four years, resulting in 40 observations. The exclusion of provinces was solely based on data availability considerations.

Data Collection Method

This study relies exclusively on publicly available secondary data obtained from official statistical publications and institutional reports. The digitalization index is constructed using *E-Commerce Statistics* published by Statistics Indonesia (BPS, 2020–2023). This indicator captures the proportion of MSMEs utilizing digital platforms in their business activities. AI adoption is proxied using the AI Readiness Index reported by Salesforce (2023). Since provincial-level AI indicators are not available, the index is treated as a time-varying national technological exposure measure rather than a province-specific adoption indicator.

Religiosity is measured using data from the *Hasil survei budaya organisasi Badan Pusat Statistik 2022* (Organizational Culture and Social Survey 2022) (BPS, 2023). Given the relatively short observation period, religiosity is treated as a relatively stable socio-cultural characteristic across provinces. Labor productivity, which serves as the dependent variable, is calculated as the ratio of provincial gross regional domestic product (GRDP) to total employment using data from *Labor Force Statistics* (BPS, 2020–2023). Data extraction procedures involved the use of Tabula and PDFplumber software to retrieve statistical information from official documents. To reduce the possibility of transcription errors, the extracted data underwent an independent double-coding process prior to analysis.

Data Analysis Method

The primary empirical analysis employs a fixed effects (FE) panel regression model to account for time-invariant provincial characteristics that may influence labor productivity. The choice between fixed effects and random effects estimators is determined through the Hausman test, which indicates that the fixed effects specification is more appropriate for the dataset. Heteroskedasticity-consistent (HC1) robust standard errors are used to address potential heteroskedasticity within the panel structure.

The model includes the digitalization index and AI proxy as the principal explanatory variables. An interaction term between digitalization and religiosity is incorporated to examine whether socio-religious context moderates the relationship between digital transformation and labor productivity. Given the limited variation in religiosity and the relatively short panel structure ($N = 10$; $T = 4$), the estimated relationships are interpreted as conditional associations rather than definitive causal effects.

To complement the econometric estimation, the study also utilizes Double Machine Learning (DML), Causal Forest, and XGBoost models as supplementary analytical tools. These methods are intended to explore potential non-linear relationships and assess relative variable importance across predictors. However, due to the small sample size, the results from these machine learning models are interpreted cautiously and treated as supporting evidence rather than standalone inferential findings.

All analytical procedures were conducted using the R programming language and documented through RMarkdown to support transparency and reproducibility. Since the study exclusively uses aggregated public data, no individual-level information is involved in the analysis. Several methodological limitations are acknowledged, including the reliance on a national AI proxy and the relatively short panel duration, both of which inform the cautious interpretation of the empirical results.

RESULTS AND DISCUSSION

Results

Trend of MSME Labor Productivity

Figure 1 illustrates a consistent upward trend in average MSME labor productivity during the 2020–2023 period. The gradual increase suggests that Indonesian MSMEs experienced improving productive performance over time, coinciding with the broader expansion of digitalization across business activities. Although the magnitude of improvement varied across provinces, the overall pattern indicates a positive structural trend in labor productivity throughout the observation period.

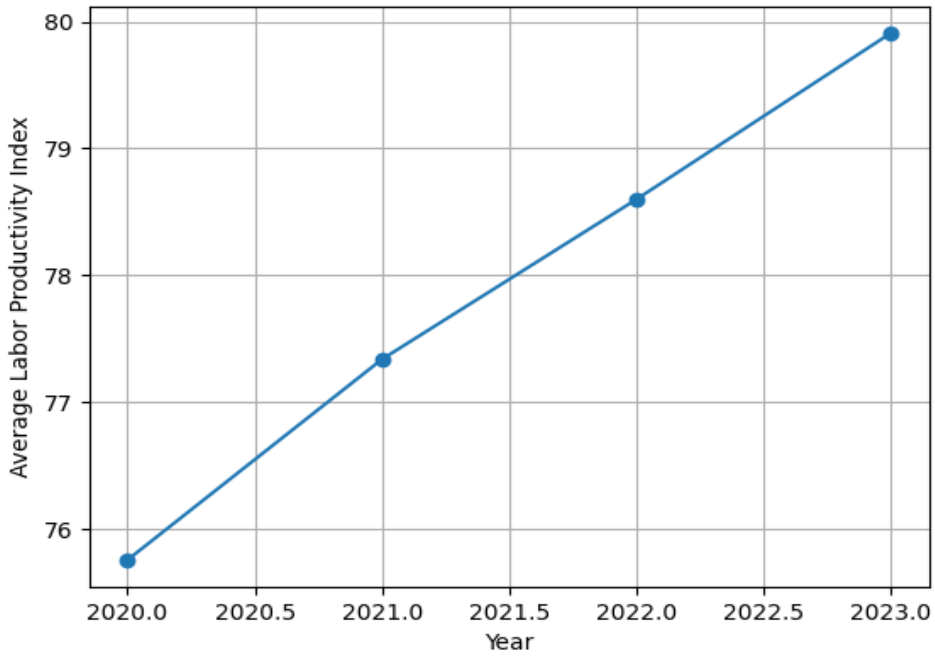

Figure 1. Average MSME Labor Productivity Trend (2020–2023)
(Source: Author's calculation based on BPS MSME Statistics).

Fixed Effects Estimation

Table 1 presents the primary fixed effects estimation using heteroskedasticity-consistent robust standard errors. The Hausman test results reported in Table 4 strongly reject the random effects specification ($\chi^2 = 18.549$; $p < .001$), indicating that province-specific unobserved characteristics are correlated with the explanatory variables. Consequently, the fixed effects model is selected as the main empirical specification.

Table 1. Fixed Effects Model (Robust Standard Errors)

Variable	Coefficient	Robust Std. Error	t-statistic	p-value	Significance
Digital Index	0.626	0.097	6.426	0	***
AI Adoption	0.038	0.090	0.415	0.6811	n.s.
Constant	—	—	—	—	—
Observations	40				
Provinces	10				
Years	4				
R^2 (Within)	0.937				
Adj. R^2	0.912				
Model	Fixed Effects (Province)				
SE Type	HC1 Robust				

**** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$; n.s. = not significant.*

The findings show that the Digital Index has a positive and statistically significant relationship with labor productivity ($\beta = 0.626$; $p < .01$). This result indicates that higher levels of MSME digitalization are consistently associated with improved productivity across provinces over time. Substantively, a one-unit increase in the digitalization index corresponds to an average increase of 0.626 units in labor productivity, holding other variables constant. The within R^2 value of 0.937 suggests that the model explains a substantial proportion of intra-provincial variation in productivity.

In contrast, AI Adoption does not demonstrate a statistically significant relationship with labor productivity ($\beta = 0.038$; $p = .681$). This pattern suggests that AI utilization among Indonesian MSMEs during the observation period remained limited, experimental, or insufficiently integrated into core operational and human resource management processes to generate measurable productivity effects.

Random Effects Estimation

Table 2 reports the random effects model for comparison purposes. The direction and magnitude of the coefficients remain broadly consistent with the fixed effects estimation. The Digital Index continues to show a strong positive association with productivity, while AI Adoption remains statistically insignificant.

Religiosity also does not exhibit a statistically significant direct effect on labor productivity ($p = .175$). This finding indicates that cultural-religious context may influence productivity indirectly

or through interaction mechanisms rather than functioning as a direct determinant of economic performance.

Table 2. Random Effects Model (Comparison)

Variable	Coefficient	Std. Error	z-statistic	p-value	Significance
Digital Index	0.600	0.055	10.916	0.000	***
AI Adoption	0.061	0.066	0.928	0.354	n.s.
Religiosity	-0.099	0.073	-1.356	0.175	n.s.
Constant	36.195	7.258	4.987	0.000	***
Observations	40				
R^2	0.943				

*Note: *** p < .01; ** p < .05; * p < .10; n.s. = not significant.*

Moderation Analysis

Table 3 examines the moderating role of religiosity through the interaction between the Digital Index and Religiosity. The interaction term is negative and marginally significant ($\beta = -0.021$; $p = .081$), indicating that the marginal productivity gains associated with digitalization tend to weaken slightly in provinces characterized by higher religiosity levels.

Table 3. Fixed Effects Model with Interaction Term

Variable	Coefficient	Robust Std. Error	t-statistic	p-value	Significance
Digital Index	2.215	0.898	2.467	0.020	**
AI Adoption	0.088	0.080	1.106	0.279	n.s.
Digital Index × Religiosity	-0.021	0.012	-1.811	0.081	*
Observations	40				
Model	Fixed Effects (Province)				

*Note: *** p < .01; ** p < .05; * p < .10; n.s. = not significant.*

This pattern may reflect transitional adaptation costs, institutional caution, or slower integration of rapidly changing technological practices within value-sensitive environments. At the same time, the direct effect of digitalization remains positive and statistically significant, indicating that digital transformation continues to contribute positively to labor productivity even within stronger cultural-religious contexts.

Model Selection Test

The Hausman test confirms that the fixed effects estimator is more appropriate than the random effects specification for this dataset. The statistically significant result indicates that unobserved provincial characteristics are correlated with the explanatory variables, making the random effects assumption inconsistent.

Table 4. Hausman Test

Test	Chi-square	df	p-value	Conclusion
Hausman	18.549	2	0.000094	Fixed Effects preferred

Overall, the empirical findings reveal three important patterns. First, digitalization emerges as a strong and consistent driver of MSME labor productivity across Indonesian provinces. Second, AI adoption has not yet produced measurable productivity gains during the observation period, suggesting a gap between technological availability and effective organizational integration.

Third, cultural-religious contexts appear to shape the effectiveness of digital transformation through a moderating mechanism rather than through a direct productivity effect.

Discussion

Regional Variation in MSME Digitalization

The variation in MSME digitalization across Indonesian provinces indicates that digital transformation extends beyond the simple adoption of digital tools or online platforms. Rather, it represents a broader socio-institutional process that reshapes organizational routines, managerial practices, human capacity, and patterns of coordination within business environments. Provinces with more developed digital ecosystems tend to integrate technology into core operational activities, including inventory management, digital marketing, customer engagement, and data-driven decision-making (Riza et al., 2022). This pattern aligns with the argument of Wulan et al. (2024), who emphasizes that digitalization contributes to productivity and profitability when supported by institutional stability and collaborative networks.

From an Ibn Khaldunian perspective, the effectiveness of technology depends not solely on technical infrastructure but also on the strength of social cohesion and collective discipline embodied in *asabiyyah*. Technological transformation becomes economically meaningful when supported by trust, shared learning, and institutional cooperation. The upward trend in MSME labor productivity observed during the study period reflects gradual improvements in organizational adaptability and learning capacity, suggesting that digitalization can generate sustained efficiency gains when accompanied by broader capability development.

At the same time, disparities across provinces reveal uneven levels of *umran* or civilizational development. Provinces with limited digital infrastructure and weaker institutional support often exhibit shallow forms of digitalization, where technology use remains confined to social media promotion or basic digital transactions without substantial changes in managerial systems or production processes. Diptyana et al. (2022) notes that digital literacy involves not only operational competence but also strategic understanding regarding the role of technology in creating long-term organizational value. The present findings suggest that fragmented institutional support and limited strategic orientation continue to constrain deeper digital transformation in less-developed regions.

Organizational Readiness and Work Culture

Differences in digital productivity outcomes are also closely associated with organizational readiness and workplace culture. Hendrawan et al. (2024) finds that limited technical competence and resistance to organizational change often hinder effective digital adoption. Similarly, Suyanto (2023) highlights the importance of social support mechanisms, including mentoring systems, peer learning, and community-based knowledge exchange, in sustaining digital adaptation processes.

These observations resonate with Ibn Khaldun's emphasis on *ta'awun* (mutual assistance) as a foundation of productive social organization. Digital transformation therefore requires more than technological investment alone. Organizations also need learning-oriented cultures that encourage adaptability, collaboration, and collective responsibility. In this context, institutional

trust and internal coordination become critical factors influencing whether digital initiatives can be translated into sustained productivity improvements.

Cross-Actor Collaboration and Institutional Coordination

The findings further indicate that successful MSME digitalization depends on coordinated interaction among multiple institutional actors, including government agencies, universities, industry networks, and technology providers. Coco et al. (2023) argue that innovation is strengthened through co-creation and inter-institutional knowledge exchange rather than isolated organizational efforts. Provinces characterized by stronger collaborative ecosystems appear to demonstrate deeper digital integration and more stable productivity growth.

Within Ibn Khaldun's framework, such coordination reflects *tadbir al-'umran*, namely the ethical governance of collective resources and institutional continuity necessary for long-term development. However, the results also reveal that policy fragmentation and uneven administrative capacity may weaken the effectiveness of digitalization programs. Leadership turnover, shifting priorities, and inconsistent implementation can reduce institutional continuity and limit the sustainability of productivity gains.

The stronger empirical influence of the Digital Index compared with AI-related indicators reinforces the importance of institutional embedding over programmatic expansion alone. In other words, the productivity benefits of digitalization depend less on the presence of technological initiatives and more on the extent to which these initiatives become integrated into organizational and institutional practices.

The Role of Artificial Intelligence

Although artificial intelligence is frequently associated with automation, predictive analytics, and service personalization (Felix & Gabriel, 2024; Senadjki et al., 2023), the empirical results indicate that AI adoption has not yet generated statistically significant productivity gains among Indonesian MSMEs. This finding suggests that AI utilization remains relatively limited and has not been fully integrated into core business operations, decision-making processes, or human resource management systems.

This interpretation is consistent with the findings of Al-Emran and Griffy-Brown (2023) and Chourasiya and Malviya (2025), who argue that organizational acceptance of AI depends not only on technological availability but also on perceptions of fairness, transparency, usefulness, and employee readiness. Many MSMEs may still lack the technical expertise, financial capacity, or organizational infrastructure required to operationalize AI technologies effectively.

From a Khaldunian perspective, technological instruments alone cannot substitute for institutional maturity and ethical governance. Productivity gains emerge when technology operates within coherent organizational structures and coordinated collective practices. The weak statistical effect of AI in this study therefore appears to reflect limitations in organizational readiness, absorptive capacity, and managerial integration rather than an absence of technological potential.

Religiosity, Human Resource Efficiency, and Asabiyyah

The moderation analysis indicates that religiosity slightly weakens the marginal productivity effect of digitalization, although the overall impact of digitalization remains positive and significant. This finding suggests that cultural-religious norms function as institutional filters that shape how technological transformation is interpreted and adapted within organizational settings.

Strong normative cohesion may strengthen discipline, trust, and social stability, yet it may also encourage cautious adaptation when technological change is perceived as inconsistent with established values or routines. Importantly, this pattern should not be interpreted as resistance to technology itself. Rather, it reflects transitional adjustment processes in which organizations seek to align technological practices with prevailing ethical and cultural expectations.

At the same time, the broader literature highlights the positive role of religiosity in organizational behavior and human resource performance. Yousaf (2024) emphasizes that human resource efficiency remains a major determinant of productivity improvement. Rehman et al. (2021) and Alavi et al. (2024) further note that knowledge management and continuous learning transform individual competencies into collective organizational capacity.

Several empirical studies also associate religiosity with positive organizational outcomes. Onjewu et al. (2023) show that religiosity can strengthen employee discipline and ethical commitment. Ali (2023) finds that religious orientation contributes to psychological resilience and persistence in workplace settings. Hasan et al. (2022) highlights the role of religiosity in fostering interpersonal trust and cooperative behavior, while Kusuma et al. (2021) emphasizes its contribution to long-term work motivation and moral responsibility.

Within Ibn Khaldun's conceptual framework, these dynamics illustrate the constructive dimension of *asabiyyah*, where shared moral values channel individual effort toward collective productivity and institutional coherence. The marginally negative interaction effect observed in this study therefore appears to reflect adaptive friction during periods of technological transition rather than an inherent incompatibility between religiosity and digital transformation.

Implications for Digital Transformation and Institutional Development

Overall, the findings suggest that MSME digital transformation is fundamentally socio-institutional rather than purely technological. Digital tools function primarily as enabling instruments, while sustainable productivity growth depends on organizational culture, human capability, institutional consistency, and ethical governance.

This interpretation aligns closely with Ibn Khaldun's theory, which emphasizes that the strength of *asabiyyah*—manifested through trust, shared purpose, cooperation, and coordinated governance—determines whether technological progress can generate durable economic outcomes. In the Indonesian MSME context, productivity gains appear strongest where digitalization is accompanied by institutional continuity, collaborative ecosystems, and adaptive organizational cultures.

The findings also highlight several practical implications. Government initiatives may benefit from prioritizing long-term ecosystem development rather than fragmented short-term programs. Greater coordination between national and regional institutions could strengthen the continuity of digital transformation policies. Educational institutions may also play an important role in integrating technical digital skills with ethical reasoning, collaborative competence, and adaptive learning capacities.

At the organizational level, MSMEs may need to invest more substantially in leadership development, organizational learning systems, and value-based management practices to ensure that technology strengthens rather than displaces human development processes.

CONCLUSION

The findings indicate that digitalization serves as a strong and consistent determinant of labor productivity among Indonesian MSMEs. Provinces with higher levels of digital integration tend to demonstrate stronger productivity performance, suggesting that digital transformation has become an important component of organizational efficiency and economic adaptation in the MSME sector. In contrast, AI adoption has not yet produced statistically measurable productivity gains during the observation period, reflecting limited organizational readiness and the incomplete integration of AI technologies into core managerial and operational processes. The moderation analysis further reveals that religiosity influences the effectiveness of digital transformation in nuanced ways. Rather than functioning as a barrier to innovation, cultural-religious context appears to shape the pace and institutional acceptance of technological change. Interpreted through Ibn Khaldun's concepts of *asabiyyah* and *tadbir al-'umran*, these findings suggest that technological progress contributes to sustainable productivity when supported by social cohesion, ethical governance, institutional continuity, and collective learning capacity.

This study contributes to the literature on Islamic economics and management by extending Ibn Khaldun's institutional perspective into contemporary discussions of digital transformation and MSME productivity. The findings reinforce the view that digital transformation should not be understood solely as technical modernization, but as a socio-institutional process shaped by organizational culture, governance quality, and collective adaptation mechanisms. From a practical perspective, the results highlight the importance of ecosystem-oriented policies that strengthen institutional coordination, human capital development, and long-term policy consistency. Efforts to accelerate MSME digitalization may therefore require stronger collaboration among government institutions, educational organizations, technology providers, and local business communities to ensure that technological innovation is accompanied by organizational capability development and ethical governance practices.

Several limitations should be acknowledged in interpreting the findings of this study. The analysis relies on aggregated provincial-level data and uses a national AI readiness indicator as a proxy for AI exposure, which may not fully capture variations in firm-level technological adoption. The relatively short panel period and limited sample size also constrain the ability to observe long-term dynamics of digital transformation and institutional adaptation. Future research may benefit from incorporating firm-level datasets, longitudinal observations, and qualitative approaches such as interviews, case studies, or ethnographic analysis to better

understand how digital practices, organizational culture, and social learning processes evolve within MSMEs. Such approaches would provide deeper insight into the micro-level mechanisms through which *asabiyyah* and institutional coherence shape the sustainability of digital transformation in contemporary economic settings.

REFERENCES

Al-Emran, M., & Griffy-Brown, C. (2023). The role of technology adoption in sustainable development: Overview, opportunities, challenges, and future research agendas. *Technology in Society, 73*, 102240. https://doi.org/10.1016/j.techsoc.2023.102240

Alavi, M., Leidner, D. E., & Mousavi, R. (2024). A knowledge management perspective of generative artificial intelligence. *Journal of the Association for Information Systems, 25*(1), 1–12. https://doi.org/10.17705/1jais.00859

Ali, J. (2023). Does religiosity affect entrepreneurial intention across countries? *International Journal of Sociology and Social Policy, 43*(11/12), 1218–1238. https://doi.org/10.1108/IJSSP-11-2022-0303

Asosiasi Penyelenggara Jasa Internet Indonesia. (2024). *Jumlah pengguna internet Indonesia tembus 221 juta orang*. https://apjii.or.id/berita/d/apjii-jumlah-pengguna-internet-indonesia-tembus-221-juta-orang

Athey, S., & Wager, S. (2018). Estimating treatment effects with causal forests: An application. *Proceedings of the National Academy of Sciences, 115*(11), 2237–2242. https://doi.org/10.1073/pnas.1510489115

Aulia, R., Ibrahim, A., & Tarigan, I. R. R. (2020). Operasionalisasi lembaga keuangan baru dan dampaknya terhadap pertumbuhan usaha mikro. *JIHBIZ: Global Journal of Islamic Banking and Finance, 2*(1), 57–81. https://doi.org/10.22373/jihbiz.v2i1.8579

Badan Pusat Statistik. (2020–2023). *Statistik e-commerce* (edisi 2020–2023). https://www.bps.go.id

Badan Pusat Statistik. (2023). *Hasil survei budaya organisasi Badan Pusat Statistik 2022*. https://www.bps.go.id/id/publication/2023/09/01/aeb2073a27513ef51b84ebaf/hasil-survei-budaya-organisasi-badan-pusat-statistik-2022.html

Chernozhukov, V., Chetverikov, D., Demirer, M., Duflo, E., Hansen, C., Newey, W., & Robins, J. (2022). Double/debiased machine learning for treatment and structural parameters. *The Econometrics Journal, 25*(3), C1–C38. https://doi.org/10.1093/ectj/utac018

Chourasiya, R., & Malviya, R. K. (2025). Factors influencing technology adoption for sustainability in manufacturing firms: An empirical analysis and literature review. *Sustainable Development*. Advance online publication. https://doi.org/10.1002/sd.3298

Coco, N., Colapinto, C., & Finotto, V. (2023). Fostering digital literacy among small and micro-enterprises: Digital transformation as an open and guided innovation process. *R&D Management, 54*(2), 265–281. https://doi.org/10.1111/radm.12645

Diptyana, P., Rokhmania, N., & Herlina, E. (2022). Financial literacy, digital literacy and financing preferences role to micro and small enterprises' performance. *International Journal of Entrepreneurship and Business Development, 5*(2), 346–359. https://doi.org/10.29138/ijebd.v5i2.1814

Duranti, A. (1997). *Linguistic anthropology*. Cambridge University Press.

Felix, G., & Gabriel, M. (2024). Artificial intelligence-driven competitiveness: Enhancing SME performance in the global market. *International Journal of Business Analytics and*

Intelligence, 12(1), 45–58.

Foley, W. A. (1997). *Anthropological linguistics: An introduction*. Blackwell Publishers.

Gélinas, D., Sadreddin, A., & Vahidov, R. (2022). Artificial intelligence in human resources management: A review and research agenda. *Proceedings of the Association for Information Systems, 14*(6), 1–16. https://doi.org/10.17705/1pais.14601

Hasan, R. R., Samdin, N., Wonua, A. N., & Hatani, L. (2022). Moderating role of Islamic work ethics on innovation and entrepreneurial orientation. *Quality – Access to Success, 23*(188), 270–278. https://doi.org/10.47750/QAS/23.188.38

Hendrawan, S. A., Chatra, A., Iman, N., Hidayatullah, S., & Suprayitno, D. (2024). Digital transformation in MSMEs: Challenges and opportunities in technology management. *Jurnal Informasi dan Teknologi, 6*(2), 141–149. https://doi.org/10.60083/jidt.v6i2.556

Ibn Khaldun. (1967). *The Muqaddimah: An introduction to history* (F. Rosenthal, Trans.; 2nd ed., Vols. 1–3). Princeton University Press. (Original work published 1377).

Irmawati, A., & Jaharuddin, J. (2024). Integrating Islamic values in digital business practices: Toward ethical transformation in Indonesia. *Journal of Islamic Economics and Business Studies, 5*(1), 55–70.

Kamar Dagang dan Industri Indonesia. (2024). *Kadin pushes MSME digitalization to boost business*. Antara News. https://en.antaranews.com/news/311835/kadin-pushes-msme-digitalization-to-boost-business

Kamri, N. A., Ramlan, S., & Ibrahim, A. (2014). Qur'anic work ethics. *Journal of Usuluddin, 40*, 135–172. https://doi.org/10.22452/usuluddin.vol40.6

Kementerian Koperasi dan Usaha Kecil dan Menengah Republik Indonesia. (2024). *Puluhan juta UMKM telah bertransformasi digital*. https://rri.co.id/umkm/1047154/kemenkopukm-catat-puluhan-juta-umkm-telah-bertransformasi-digital

Kusuma, A. D., Nurdiono, N., Fajar, G., Agrianti, K., & Yuliansyah, Y. (2021). Effects of strategic performance measurement system and Islamic work ethics on firm performance. *Ilkogretim Online, 20*(6), 781–796. https://doi.org/10.17051/ilkonline.2021.06.081

Onjewu, A.-K. E., Anosike, P., & Godwin, E. S. (2023). The mediating role of planned behaviour in the religiosity and nascent entrepreneurship nexus. *International Journal of Entrepreneurial Behavior & Research, 29*(8), 1950–1969. https://doi.org/10.1108/IJEBR-08-2022-0771

Petre, A.-G. (2025). Artificial intelligence: A new era of human resource management for enhancing employee efficiency in the healthcare sector. *Revista de Management Comparat International, 26*(3), 529–537. https://doi.org/10.24818/RMCI.2025.3.529

Rehman, F. U., Ismail, H., Al Ghazali, B. M., Asad, M. M., Shahbaz, M. S., & Zeb, A. (2021). Knowledge management process, knowledge-based innovation: Does academic researcher's productivity mediate? *PLOS ONE, 16*(4), e0261573. https://doi.org/10.1371/journal.pone.0261573

Riza, A., Ibrahim, A., & Azhar, F. (2022). Teknologi informasi dan kualitas layanan mempengaruhi tingkat kepuasan nasabah bank syariah. *JIMEBIS: Scientific Journal of Students Islamic Economics and Business, 3*(1), 7–15. https://doi.org/10.22373/jimebis.v3i1.247

Salesforce. (2023). *Asia Pacific AI readiness index 2023*. https://www.salesforce.com/content/dam/web/en_sg/www/documents/pdf/salesforce_ai_readiness_index_2023.pdf

Senadjki, A., Ogbeibu, S., Mohd, S., Au Yong, H. N., & Awal, I. M. (2023). Harnessing artificial

intelligence for business competitiveness in achieving sustainable development goals. *Journal of Asia-Pacific Business, 24*(3), 149–169. https://doi.org/10.1080/10599231.2023.2220603

Suyanto, B., Sugihartati, R., Egalita, N., Mas'udah, S., Singgih, D. S., & Sudarso. (2023). Digital literacy and survival mechanism of micro-small enterprises in practicing sharing economy. *Cogent Social Sciences, 9*(1), 2185647. https://doi.org/10.1080/23311886.2023.2185647

Utami, A. P., Ibrahim, A., & Adnan, M. (2024). Penerapan prinsip-prinsip good governance dan penanggulangan tingkat kemiskinan di Kabupaten Aceh Barat. *Journal of Law and Economics, 3*(2), 83–98. https://doi.org/10.56347/jle.v3i2.221

Wang, Z., & Surienty, L. (2024). Unveiling artificial intelligence (AI)-recruitment processes in HRM practices on job applicants' satisfaction. *Global Business and Management Research, 16*(4s), 417–434.

Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach* (6th ed.). Cengage Learning.

Wu, M. (2024). Human resource management optimization strategies for diverse work environments based on artificial intelligence. *Applied Mathematics and Nonlinear Sciences, 9*(1), 1–14. https://doi.org/10.2478/amns-2024-2556

Wulan, T. S., Putri, R. A., & Solihin, D. A. (2024). Digital transformation as a catalyst for SMEs productivity and profitability in the digital era. *Journal of Economics, Entrepreneurship, and Strategic Studies, 5*(4), 112–126. https://doi.org/10.62794/je3s.v5i4.4543

Yadav, A., & Nigam, A. (2025). Navigating AI adoption in recruitment for driving organizational performance: A systematic literature review. *Delhi Business Review, 26*(1), 65–78. https://doi.org/10.51768/DBR.V26I1.261202506

Yousaf, M. (2024). Human capital efficiency and firm performance of quality-certified firms: A dynamic panel data study. *Organizacija, 57*(2), 95–109. https://doi.org/10.2478/orga-2024-0007

Zhang, P. (2024). Application of artificial intelligence (AI) in recruitment and selection: The case of Company A and Company B. *Journal of Business and Management Studies, 6*(3), 224–225. https://doi.org/10.32996/jbms.2024.6.3.18