

MANAGEMENT ACCOUNTING SYSTEMS AND MANAGERIAL SUPPORT INFLUENCE SUSTAINABLE MANUFACTURING SME PERFORMANCE THROUGH DIGITAL TRANSFORMATION MECHANISMS

Reza Muhammad Rizqi^{1*}

Arya Zulfikar Akbar²

Fatin Nabilah Norzihad³

^{1,2} Universitas Teknologi Sumbawa, Sumbawa, Indonesia

³ Multimedia University, Selangor, Malaysia

reza.muhammad.rizqi@uts.ac.id*

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Abstract:

Purpose - Grounded in the Resource-Based View and Dynamic Capabilities Theory, this study investigates how digital transformation mediates the sustainable performance of Indonesian manufacturing SMEs. It evaluates the impact of environmental management accounting (EMA), innovative accounting instruments, and top management support on sustainability through digitalization.

Methods - Utilizing a quantitative explanatory framework, data from 210 purposively selected SME managers were analyzed via Partial Least Squares Structural Equation Modeling (PLS-SEM), assessing mediation through the Variance Accounted For (VAF) approach.

Findings - Results substantiate all proposed hypotheses. EMA, advanced instruments, and executive backing significantly propel digital transformation, elevating sustainable performance. Digital transformation operates as a partial mediator, yielding VAF values of 38.3%, 37.7%, and 39.3%.

Research implications - While digitalization amplifies sustainability, managerial interventions remain indispensable. This study provides strategic insights for policymakers to synchronize modern accounting frameworks and leadership commitment with digital advancements.

Originality - This research offers empirical value by quantifying the specific mediating role of digital transformation, proving how integrating technological capabilities and managerial resources actively fosters sustainable competitiveness in emerging-market manufacturing SMEs.

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INTRODUCTION

Advances in digital technology have brought fundamental changes to the dynamics of the global economy, including the Small and Medium Enterprises (SMEs) manufacturing sector in Indonesia. Facing increasingly intense competition and demands for business sustainability, SMEs are required not only to survive but also to continuously improve their performance. Digital transformation is a key element in addressing these challenges, providing opportunities for increased operational efficiency, expanded market reach, and real-time data integration. According to data from the Ministry of Cooperatives and SMEs, approximately 17.2 million SMEs have adopted digital technology by 2022, with that number increasing to 27 million by 2023. However, this figure remains relatively small compared to the total 65.4 million SMEs in Indonesia, indicating that the level of digital adoption still needs to be significantly increased ([Sun, 2024](#)). This situation indicates that a significant digital divide persists, with most SMEs, particularly in the manufacturing sector, unable to optimize the use of technology to strengthen their competitiveness and business sustainability. Barriers such as limited infrastructure, low digital literacy, and limited access to funding are key inhibiting factors, necessitating strategic and collaborative steps from the government and stakeholders to accelerate the digital inclusion process and achieve an inclusive and sustainable transformation.

Environmental management accounting (EMA) is gaining increasing relevance in helping SMEs manage their ecological impacts through monitoring energy use, waste management, and optimizing resource efficiency. The implementation of EMA provides a basis for companies to make more sustainability-oriented decisions through the provision of integrated and comprehensive accounting information. Furthermore, various modern management accounting instruments, such as the balanced scorecard, activity-based costing, and environmental benchmarking, play a crucial role in supporting strategic planning and organizational performance control. However, the implementation of these instruments often faces obstacles such as limited resources and a lack of support from top management ([Yao et al., 2024](#)). The research results show that although awareness of the importance of environmental accounting continues to increase, the application of this concept in the SME sector remains relatively limited due to low technical understanding, limited internal capacity, and minimal support and incentives from government policies. Empirically, the implementation of EMA has been shown to have a positive and significant impact on improving environmental performance because it can provide more appropriate information for strategic and operational decision-making. Therefore, the successful integration of EMA with innovative management accounting tools requires strong commitment from top management and policy support that encourages the provision of training, access to funding, and technical assistance to overcome the various structural barriers faced by SMEs ([Sandberg et al., 2020](#)).

Support from top management is essential for the successful implementation of management systems and the adoption of new technologies. Without strong commitment from top management, initiatives such as environmental management accounting (EMA) and digital transformation have the potential to fail or be unsustainable in the long term. Top management's strategic role is evident through its

involvement in allocating financial resources, establishing an adaptive organizational culture, and serving as a driving force for change ([Q. Zhao et al., 2023](#)). Various empirical studies have shown that leadership support significantly influences the effectiveness of information systems and increases organizational innovation, as visionary leadership can build shared goals, reduce resistance to change, and ensure consistency in the implementation of digital and sustainability strategies. Furthermore, active top management participation in organizational transformation processes contributes to increasing the institution's adaptability and accelerating the process of integrating technology into existing management systems ([Belhadi et al., 2022](#)).

Digital transformation is not only about the application of technology but also encompasses fundamental changes in business models, work systems, and the strategic direction of an organization. In the context of manufacturing SMEs, this transformation process has the potential to strengthen managerial and operational capabilities, ultimately contributing to improved sustainable performance. However, the relationship between environmental management accounting (EMA), innovative management accounting instruments, and top management support for sustainable performance cannot be comprehensively understood without considering the mediating role of digital transformation ([Y. Zhao et al., 2023](#)). Various studies have shown that digital transformation acts as a strategic enabler, enabling the integration of information systems, accelerating decision-making processes, and increasing transparency in performance reporting, thereby strengthening the effectiveness of managerial practices. In the context of dynamic and adaptive SMEs, digital transformation serves as a key mediator that transforms managerial initiatives into measurable performance outcomes, particularly through business process automation, real-time data integration, and expanded access to digital markets. Therefore, implementing EMA or innovative management accounting tools separately without digital transformation support is likely to yield limited benefits, given that digital capacity is a crucial prerequisite for optimizing the value and effectiveness of modern management systems ([Tsou & Chen, 2023](#)).

Despite the growing body of literature on digital transformation and sustainable SME performance, three critical research gaps remain unaddressed. First, prior studies examining EMA and its outcomes have largely focused on direct relationships with environmental performance in large enterprises, while studies situating EMA as an antecedent of digital transformation in resource-constrained manufacturing SMEs remain scarce ([Sandberg et al., 2020](#); [Verhoef et al., 2021](#)). Second, although innovative management accounting tools (e.g., Balanced Scorecard, Activity-Based Costing) have been linked to operational efficiency, their role in catalyzing digital transformation, rather than merely reflecting it has not been empirically tested within an integrated mediation framework ([Yao et al., 2024](#)). Third, while top management support is widely acknowledged as a driver of technology adoption, existing models rarely position it alongside EMA and innovative accounting tools within a unified structural model that tests simultaneous direct and mediated pathways to sustainable performance ([Belhadi et al., 2022](#); [Q. Zhao et al., 2023](#)). Critically, no prior study has integrated all three antecedents with digital transformation as a mediator in the specific context of Indonesian manufacturing

SMEs, where structural resource constraints, low digital literacy, and fragmented policy incentives create conditions qualitatively distinct from those studied in developed-economy SME settings. This study is designed to close these gaps by empirically testing a comprehensive mediation model that positions digital transformation as the mechanism through which EMA, innovative accounting tools, and top management support collectively translate into sustainable performance outcomes ([Singh et al., 2021](#)).

The main question raised in this study is how does digital transformation play a mediating role in the relationship between environmental management accounting, innovative management accounting tools, and top management support on the sustainable performance of manufacturing SMEs? The purpose of this study is to empirically test the mediating role of digital transformation within this relationship. The theoretical foundation of this study confirms that digital transformation not only acts as an independent variable but also as a mediating mechanism that strengthens the effectiveness of managerial strategies in achieving optimal organizational performance. In the context of manufacturing SMEs, digital transformation functions as an enabler that allows data integration between environmental accounting systems and innovative management accounting tools, while simultaneously expanding the influence of top management support through the implementation of automation, data analytics, and digital connectivity ([Anwar et al., 2024](#)). Prior studies have shown that digital technology can play a partial mediating role in the relationship between business strategy and SME performance, a relationship this study empirically tests in the Indonesian manufacturing SME context. Thus, this study seeks to fill this gap in the literature by testing a more comprehensive mediation model, which integrates accounting, management, and technology dimensions into a single, holistic analytical framework ([Singh et al., 2021](#)).

THEORETICAL REVIEW

Resource-Based View (RBV) and Dynamic Capabilities Theory

This study is theoretically grounded in the Resource-Based View (RBV) and Dynamic Capabilities Theory. The RBV asserts that an organization's sustainable competitive advantage originates from valuable, rare, inimitable, and non-substitutable (VRIN) resources ([Barney, 1991](#)). Within this framework, environmental management accounting (EMA), innovative management accounting tools, and top management support are essential intangible resources that drive sustainable performance in manufacturing SMEs. Specifically, EMA serves as an informational resource; innovative accounting tools function as procedural mechanisms for strategic decision-making ([Yuan et al., 2024](#)); and top management provides the human and political resources required to mobilize shared organizational goals ([Yao et al., 2024](#)). Furthermore, bundling these VRIN resources with digital capabilities substantially amplifies their contribution to sustainable outcomes. This synergy is particularly vital for resource-constrained manufacturing SMEs in emerging markets, where efficient resource reconfiguration through digitalization is a strategic necessity for long-term competitiveness ([Su & Wu, 2024](#); [Yang et al., 2023](#)).

Dynamic Capabilities Theory ([Teece, Pisano, & Shuen, 1997](#)) extends the Resource-Based View (RBV) by highlighting a firm's capacity to adapt resources to changing environments. This study conceptualizes digital transformation as a dynamic capability that enables manufacturing SMEs to reconfigure competencies for fast-changing markets. Consequently, digital transformation acts as a crucial mediating mechanism, translating static managerial resources—like environmental management accounting (EMA), innovative accounting tools, and top management support—into adaptive, sustainable performance outcomes. Recent empirical evidence supports this mediating role. [Zhang et al. \(2024\)](#) discovered that digital transformation mediates the relationship between green innovation and environmental outcomes. Furthermore, [Wu and Li \(2023\)](#) showed that robust internal management systems enhance the effectiveness of digitalization on ESG performance. Corroborating this, [Tsou and Chen \(2023\)](#) and [Tan et al. \(2024\)](#) confirmed that firms with advanced management accounting infrastructures achieve greater sustainability benefits from digital adoption, theoretically validating the mediation chain analyzed in this research.

Hypothesis Development and Conceptual Framework

Drawing on RBV and Dynamic Capabilities Theory, this study develops the following hypotheses. EMA functions as a knowledge resource that generates structured environmental information, which creates organizational readiness to adopt digital tools such as IoT-based environmental dashboards and real-time emission tracking. Therefore, H1: Environmental management accounting positively affects digital transformation. Innovative accounting tools demand cross-functional data integration that incentivizes the digitalization of managerial processes; therefore, H2: Innovative management accounting tools positively affect digital transformation. Top management support provides the strategic direction, resource allocation, and adaptive culture required to drive digital adoption; therefore, H3: Top management support positively affects digital transformation. Digital transformation, as a dynamic capability, reconfigures organizational resources into adaptive operational and reporting practices that improve sustainability outcomes; therefore, H4: Digital transformation positively affects sustainable performance.

Beyond their indirect role, EMA, innovative accounting tools, and top management support are theorized to exert direct effects on sustainable performance because each is itself a VRIN resource that, even without digital mediation, contributes to environmental, social, and economic outcomes. Therefore, H5: Environmental management accounting positively affects sustainable performance; H6: Innovative management accounting tools positively affect sustainable performance; and H7: Top management support positively affects sustainable performance. Finally, since the dynamic capability of digital transformation channels RBV resources into adaptive outcomes, H8: Digital transformation mediates the relationship between environmental management accounting and sustainable performance; H9: Digital transformation mediates the relationship between innovative management accounting tools and sustainable performance; and H10: Digital transformation mediates the relationship between top management support and sustainable performance. The conceptual framework therefore positions environmental management accounting (X1), innovative management accounting

tools (X2), and top management support (X3) as exogenous variables, digital transformation (M) as a mediating variable, and sustainable performance (Y) as the endogenous variable, with direct paths $X1 \rightarrow Y$, $X2 \rightarrow Y$, $X3 \rightarrow Y$ and indirect paths $X1 \rightarrow M \rightarrow Y$, $X2 \rightarrow M \rightarrow Y$, $X3 \rightarrow M \rightarrow Y$.

This research provides crucial empirical evidence on achieving sustainable performance in SMEs through the interaction of managerial and technological dimensions, highlighting the need for managers to integrate digital transformation strategies with accounting systems and organizational culture ([Torrent-Sellens et al., 2023](#)). Maximizing these strategic benefits requires a comprehensive approach driven by visionary leadership, strong innovative capabilities, and policy support for digital capacity development ([Senadjki et al., 2024](#)). While digitalization significantly enhances operational efficiency and profitability through greater transparency, SMEs often face adoption barriers such as limited capital and weak technological infrastructure, making top management support and appropriate management tools essential for overcoming these challenges ([Senadjki et al., 2024](#)). Ultimately, successful digital adoption relies on management commitment to utilize integrated information systems and innovative accounting instruments, confirming that synergy among leadership, effective management systems, and a conducive digital ecosystem is a fundamental prerequisite for SME sustainability and competitiveness ([Enrique et al., 2022](#)).

Addressing a gap in the literature, this study utilizes a quantitative structural equation modeling (SEM) approach to test a comprehensive mediation model that positions digital transformation as a vital reinforcing mechanism between managerial practices and organizational performance, expanding upon prior frameworks that focused solely on direct relationships ([Verhoef et al., 2021](#)). By enabling the simultaneous analysis of direct and indirect dynamics, this research offers holistic, practical guidance for developing adaptive and sustainable management systems ([Yang et al., 2023](#)). Consequently, the findings underscore a paradigm shift from viewing digitalization as a simple operational tool to recognizing it as a strategic capability that effectively integrates accounting systems, managerial innovation, and leadership support as a key mediating variable ([Arias-Pérez et al., 2022](#)). Given the resource constraints typical of manufacturing SMEs, understanding this mediating role provides essential insights for both business managers formulating integrated strategies and policymakers designing targeted digital training, mentoring, and incentive schemes to foster sustainable performance ([Yousaf et al., 2021](#)).

RESEARCH METHODS

This study employs a quantitative explanatory design to test direct and mediated causal relationships among environmental management accounting (X1), innovative management accounting tools (X2), top management support (X3), digital transformation (M), and sustainable performance (Y) in Indonesian manufacturing SMEs. PLS-SEM was selected because it handles complex latent-variable models without requiring multivariate normality, making it well-suited for SME-context data (X. Zhang et al., 2023). The structural model specifies seven paths: $X1 \rightarrow M$, $X2 \rightarrow M$,

$X3 \rightarrow M$, $M \rightarrow Y$, $X1 \rightarrow Y$, $X2 \rightarrow Y$, and $X3 \rightarrow Y$, with standardized coefficients estimated via SmartPLS 4 bootstrapping (5,000 resamples, two-tailed, $\alpha = 0.05$).

The population comprised all manufacturing SMEs registered with Indonesia's Ministry of Cooperatives and SMEs. Respondents were managers or owners – individuals with direct authority over strategic decisions including environmental initiatives, digitalization adoption, and performance control – selected via purposive sampling with four criteria: (1) official SME classification, (2) operation in the manufacturing sector, (3) at least three years in business, and (4) active use of or ongoing adoption of digital technology. Following the SEM guideline of 5–10 observations per indicator, a minimum of 200 valid responses was required ([Su & Wu, 2024](#)). Of 250 questionnaires distributed across five provinces (West Java, East Java, Central Java, Banten, and North Sumatra) via a hybrid online-offline approach supported by SME associations and government agencies, 210 complete responses were returned (response rate: 84%). A pilot test with 30 SMEs confirmed item clarity and instrument stability prior to full deployment ([AlMulhim, 2021](#)).

Data were collected via a closed-ended questionnaire adapted from previously validated scales and measured on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). Each of the five constructs was operationalized with four to six reflective indicators. Outer-model quality was assessed using loading factor ≥ 0.7 , AVE > 0.5 (convergent validity), Fornell-Larcker criterion and HTMT < 0.85 (discriminant validity), and Cronbach's Alpha and CR ≥ 0.7 (internal reliability). Inner-model assessment included path coefficients (bootstrapping, $t > 1.96$), R^2 , effect size f^2 , and predictive relevance Q^2 via blindfolding ([S. Wu & Li, 2023](#); [W. Wu et al., 2023](#)). Data integrity was verified by screening for straight-lining, inconsistent responses, and incomplete questionnaires prior to analysis ([Shehadeh et al., 2023](#)).

Analysis employed PLS-SEM in SmartPLS 4 in two stages. First, outer-model validity and reliability were confirmed (loading ≥ 0.7 ; AVE > 0.5 ; HTMT < 0.85 ; CR and Cronbach's $\alpha \geq 0.7$). Second, the structural model was evaluated via bootstrapping (5,000 resamples; $t > 1.96$; $\alpha = 0.05$), with R^2 , f^2 , and Q^2 reported. Mediation was quantified by the Variance Accounted For (VAF) method: VAF = indirect / (direct + indirect), with partial mediation defined as 20–80% and full mediation as $> 80\%$. Common method bias was screened via Harman's single-factor test; the first unrotated factor explained 32.7% of variance (below the 50% threshold), confirming that CMV is not a substantial threat ([Podsakoff et al., 2003](#)).

RESULTS AND DISCUSSION

Table 1. Respondent Demographic Profile (n = 210)

Characteristic	Category	Frequency	%
Gender	Male	134	63.8
	Female	76	36.2
Position	Owner	118	56.2
	Manager / Director	92	43.8
Years of Operation	3 – 5 years	71	33.8
	6 – 10 years	88	41.9
	> 10 years	51	24.3
Firm Size	Small (5–19 employees)	112	53.3
	Medium (20–99 employees)	98	46.7

Source: data processed, 2026

Table 1 summarizes the demographic profile of the 210 respondents. The sample is dominated by male respondents (63.8%), while owners (56.2%) slightly outnumber managers and directors (43.8%), indicating that responses were provided by individuals with direct authority over strategic decisions. In terms of operating experience, the majority of firms (41.9%) have been active for six to ten years, followed by those operating three to five years (33.8%) and more than ten years (24.3%), which confirms that the respondents possess sufficient business maturity to assess digital transformation and sustainable performance. The distribution between small (53.3%) and medium (46.7%) enterprises is relatively balanced, ensuring that the findings reasonably represent both firm-size categories within the Indonesian manufacturing SME sector.

Table 2. Descriptive Statistics of Research Variables

Variable	Min	Max	Mean	SD
Environmental Mgmt Accounting (X1)	1.50	5.00	3.84	0.71
Innovative Accounting Tools (X2)	1.75	5.00	3.91	0.68
Top Management Support (X3)	2.00	5.00	4.02	0.65
Digital Transformation (M)	1.75	5.00	3.78	0.74
Sustainable Performance (Y)	2.00	5.00	3.89	0.69

Source: data processed, 2026

Table 2 presents the descriptive statistics of the five research variables. All constructs recorded mean values ranging from 3.78 to 4.02 on a five-point Likert scale, indicating that respondents generally perceived the implementation of environmental management accounting, innovative accounting tools, top management support, digital transformation, and sustainable performance as relatively high. Top management support obtained the highest mean (4.02), suggesting that managerial commitment is the most strongly perceived dimension, whereas digital transformation recorded the lowest mean (3.78), reflecting that digital adoption remains the area with the greatest room for improvement. The standard deviation values, which range from 0.65 to 0.74, are relatively small and homogeneous, indicating limited dispersion and consistent response patterns across the sample.

Table 3. Results of Instrument Validity and Reliability Tests

Construct	Indicator	Loading Factor	AVE	Composite Reliability	Cronbach's Alpha
Environmental Management Accounting (X1)	X11	0.87	0.68	0.89	0.86
	X12	0.85			
	X13	0.88			
	X14	0.84			
	X21	0.89			
Innovative Management Accounting Tools (X2)	X22	0.86	0.71	0.91	0.88
	X23	0.90			
	X24	0.87			
	X31	0.91			
Top Management Support (X3)	X32	0.89	0.75	0.93	0.90
	X33	0.92			
	X34	0.88			
	M1	0.85			

Construct	Indicator	Loading Factor	AVE	Composite Reliability	Cronbach's Alpha
Digital Transformation (M)	M2	0.83	0.70	0.90	0.87
	M3	0.86			
	M4	0.84			
Sustainable Performance (Y)	Y1	0.88			
	Y2	0.87			
	Y3	0.89			

Source: data processed, 2026

The testing instrument results indicate that all constructs in this study meet adequate validity and reliability criteria. The loading factor values for all indicators are above 0.7, confirming good convergent validity, where each indicator can explain more than 50% of the variance of the latent construct it measures. In addition, the Average Variance Extracted (AVE) value for all variables exceeds 0.5, indicating that the construct explains the variance of its indicators significantly compared to measurement error. In terms of reliability, both Composite Reliability and Cronbach's Alpha have values above 0.7, indicating strong internal consistency, although Composite Reliability is superior in the context of PLS-SEM because it provides more accurate and bias-free estimates than Cronbach's Alpha, especially in models with a non-uniform number of indicators. The discriminant validity test using the Fornell-Larcker criterion shows that the square root of the AVE of each construct is higher than the correlation between constructs, while the HTMT ratio value is below 0.85 confirms that there is no overlap between constructs, so that each construct has a clear uniqueness. Overall, these results indicate that the measurement model meets all the quality criteria required in PLS-SEM analysis, so that the research instrument can be considered valid and reliable for use in the next stage of structural model analysis ([Sui & Yao, 2023](#)).

Table 4. Discriminant Validity – Fornell-Larcker Criterion

Construct	X1	X2	X3	M	Y
EMA (X1)	0.825	–	–	–	–
Innov. Tools (X2)	0.512	0.843	–	–	–
Top Mgt Support (X3)	0.487	0.546	0.866	–	–
Digital Transf. (M)	0.498	0.531	0.602	0.806	–
Sustain. Perf. (Y)	0.523	0.567	0.589	0.621	0.837

Source: data processed, 2026

Table 4 reports the discriminant validity assessment based on the Fornell-Larcker criterion. The square root of the average variance extracted (AVE) for each construct, shown on the diagonal, exceeds its correlations with all other constructs in the corresponding rows and columns. For example, the square root of the AVE for environmental management accounting (0.825) is greater than its correlations with the other constructs, and the same pattern holds for innovative accounting tools (0.843), top management support (0.866), digital transformation (0.806), and sustainable performance (0.837). These results confirm that each construct is empirically distinct and shares more variance with its own indicators than with other constructs, thereby satisfying the discriminant validity requirement.

Table 5. Discriminant Validity – Heterotrait-Monotrait (HTMT) Ratio

Construct	X1	X2	X3	M	Y
EMA (X1)	-	-	-	-	-
Innov. Tools (X2)	0.586	-	-	-	-
Top Mgt Support (X3)	0.554	0.612	-	-	-
Digital Transf. (M)	0.572	0.605	0.681	-	-
Sustain. Perf. (Y)	0.598	0.643	0.665	0.702	-

Source: data processed, 2026

Table 5 presents the discriminant validity test using the Heterotrait-Monotrait (HTMT) ratio as a complementary and more rigorous criterion. All HTMT values range between 0.554 and 0.702, and are therefore consistently below the conservative threshold of 0.85. The highest ratio is observed between digital transformation and sustainable performance (0.702), which remains well within the acceptable limit. These results reinforce the Fornell-Larcker findings and provide stronger evidence that the constructs are clearly differentiated from one another, confirming that no problematic overlap exists among the latent variables in the measurement model.

Table 6. Structural Model Quality – R², f², and Q² Values

Endogenous Construct	R ²	Adjusted R ²	Q ²	Level
Digital Transformation (M)	0.548	0.541	0.354	Moderate
Sustainable Performance (Y)	0.617	0.609	0.402	Substantial

Source: data processed, 2026

Table 6 (Effect Size Summary). The f² effect sizes per structural path are reported below for transparency (Cohen, 1988: small = 0.02, medium = 0.15, large = 0.35): X₁→M: f² = 0.09 (small-to-medium); X₂→M: f² = 0.12 (small-to-medium); X₃→M: f² = 0.21 (medium); M→Y: f² = 0.28 (medium-to-large); X₁→Y: f² = 0.08 (small); X₂→Y: f² = 0.10 (small-to-medium); X₃→Y: f² = 0.14 (small-to-medium). These values confirm that top management support has the strongest influence on digital transformation, and that the mediator-to-outcome path carries the largest effect among structural paths.

To address concerns about common method bias (CMB) arising from single-source, single-wave self-report data, Harman's single-factor test was performed by loading all measurement items onto a single unrotated factor in an exploratory factor analysis. The first unrotated factor accounted for 32.7% of the total variance, which is well below the 50% threshold commonly used to flag a serious common method bias problem ([Podsakoff et al., 2003](#)). This result suggests that common method variance does not pose a substantial threat to the validity of the findings in this study, although procedural remedies such as anonymity assurance, mixing of item ordering, and clear scale anchors were also applied during data collection to further reduce the risk of CMB.

Table 7. Hypothesis Testing Results

Hypothesis	Connection	Path Coefficient (β)	p-value	Direction of Influence	Decision
H1	X1 → M	0.38	0.002	Positive	Accepted
H2	X2 → M	0.42	0.001	Positive	Accepted
H3	X3 → M	0.51	0.000	Positive	Accepted
H4	M → Y	0.47	0.000	Positive	Accepted

Hypothesis	Connection	Path Coefficient (β)	p-value	Direction of Influence	Decision
H5	$X1 \rightarrow Y$	0.29	0.008	Positive	Accepted
H6	$X2 \rightarrow Y$	0.33	0.003	Positive	Accepted
H7	$X3 \rightarrow Y$	0.37	0.001	Positive	Accepted
H8	$X1 \rightarrow M \rightarrow Y$	0.18	0.004	Positive	Accepted (Partial Mediation)
H9	$X2 \rightarrow M \rightarrow Y$	0.20	0.002	Positive	Accepted (Partial Mediation)
H10	$X3 \rightarrow M \rightarrow Y$	0.24	0.001	Positive	Accepted (Partial Mediation)

Source: data processed, 2026

Table 7 summarizes the results of hypothesis testing for the ten proposed relationships. All path coefficients are positive and statistically significant, with p-values below the 0.05 threshold, so that every hypothesis from H1 to H10 is accepted. Among the direct paths toward digital transformation, top management support exerts the strongest effect ($\beta = 0.51$), followed by innovative accounting tools ($\beta = 0.42$) and environmental management accounting ($\beta = 0.38$), while digital transformation in turn significantly influences sustainable performance ($\beta = 0.47$). The three indirect paths (H8–H10) are also significant, with coefficients ranging from 0.18 to 0.24, confirming that digital transformation partially mediates the relationships between the managerial antecedents and sustainable performance.

Table 8. Bootstrap Results: t-Statistics and 95% Confidence Intervals

Hypothesis	Path	β	t-statistic	95% CI [LL, UL]	VAF / Mediation
H1	$X1 \rightarrow M$	0.38	3.142	[0.145, 0.612]	–
H2	$X2 \rightarrow M$	0.42	3.475	[0.182, 0.658]	–
H3	$X3 \rightarrow M$	0.51	4.218	[0.273, 0.748]	–
H4	$M \rightarrow Y$	0.47	3.886	[0.232, 0.706]	–
H5	$X1 \rightarrow Y$	0.29	2.658	[0.075, 0.498]	–
H6	$X2 \rightarrow Y$	0.33	2.948	[0.108, 0.546]	–
H7	$X3 \rightarrow Y$	0.37	3.236	[0.145, 0.582]	–
H8	$X1 \rightarrow M \rightarrow Y$	0.18	2.881	[0.062, 0.308]	38.3% (Partial)
H9	$X2 \rightarrow M \rightarrow Y$	0.20	3.108	[0.075, 0.331]	37.7% (Partial)
H10	$X3 \rightarrow M \rightarrow Y$	0.24	3.428	[0.103, 0.389]	39.3% (Partial)

Source: data processed, 2026

The analysis indicates that environmental management accounting (X1) positively and significantly influences digital transformation (M) ($\beta = 0.38$, $p < 0.01$), supporting H1. EMA encourages firms' readiness and motivation to adopt digital technology for environmental data management and sustainability reporting, acting not merely as a reporting instrument but as a catalyst for organizational change. Because EMA requires precise tracking of energy use, emissions, and waste, it drives digitalization through automation, data integration, and technology-based environmental information systems such as IoT, big-data analytics, and real-time dashboards, while also fostering a culture more adaptive to innovation. EMA thus functions as a strategic enabler that strengthens environmental performance and

accelerates digital transformation by improving information capabilities and organizational readiness ([Y. Li et al., 2022](#)).

Innovative management accounting tools (X2) have a positive and significant effect on digital transformation ($\beta = 0.42, p < 0.01$), supporting H2. Tools such as the Balanced Scorecard (BSC) and Activity-Based Costing (ABC) encourage information-system integration that underpins the digitalization of managerial processes. The BSC requires cross-dimensional data integration across financial, customer, internal-process, and learning-and-growth perspectives, encouraging digital platforms for real-time data collection and analysis, while ABC's complex activity tracking and cost allocation necessitate automation and data-driven technologies. Their combined use creates demand for integrated systems such as ERP or digital dashboards – key pillars of digital transformation – so that innovative accounting tools function not only as performance-control instruments but also as strategic catalysts for digital adoption ([Yuan et al., 2024](#)).

Top management support (X3) exerts a very strong influence on digital transformation ($\beta = 0.51, p < 0.001$), supporting H3. Consistent with prior research, executive involvement is decisive in driving organizational change and allocating resources, since top management sets strategic priorities, allocates budgets, and shapes an innovation-adaptive culture, acting as a change agent that establishes the digital vision and ensures cross-functional engagement. The absence of executive commitment often causes digital initiatives to fail through weak structural support and internal resistance, whereas proactive leadership fosters experimentation and continuous learning. The highest β among the antecedents confirms that leadership plays a more dominant role than technical aspects, so top management support is a primary driver rather than a mere supporting factor in the digital transformation process ([Zhou et al., 2022](#)).

Digital transformation (M) has a positive and significant impact on sustainable performance (Y) ($\beta = 0.47, p < 0.001$), supporting H4. Digital adoption improves operational efficiency, data transparency, and innovation capacity, simultaneously strengthening the economic, environmental, and social dimensions of sustainability and supporting the Sustainable Development Goals through technologies such as AI, cloud computing, and IoT. For manufacturing SMEs, digitalization enables production automation, real-time energy monitoring, and more accurate waste management that improve environmental performance, while systems such as ERP and analytical dashboards drive cost efficiency, supply-chain optimization, and market access. Greater transparency through digital reporting also strengthens accountability to stakeholders, so that digital transformation serves as a strategic enabler integrating the three pillars of sustainability into a holistic business strategy ([T. Li et al., 2022](#)).

Environmental management accounting (X1) shows a positive and significant effect on sustainable performance ($\beta = 0.29, p < 0.01$), supporting H5. EMA helps SMEs identify and reduce environmental costs, improve resource efficiency, and ensure regulatory compliance, integrating the environmental dimension into managerial decision-making. By revealing hidden costs of waste, pollution, and energy use that traditional accounting often omits, EMA enables greater operational efficiency and

drives process innovation such as recycling and raw-material optimization, while also strengthening stakeholder trust through transparency. Even in a simplified form suited to resource-constrained SMEs, EMA improves environmental accountability and long-term competitiveness, functioning as a strategic managerial capability rather than a mere reporting instrument ([Xu et al., 2022](#)).

Innovative accounting tools (X2) and top management support (X3) were shown to have a significant effect on sustainable performance ($\beta = 0.33$ and $\beta = 0.37$, $p < 0.01$), thus supporting hypotheses H6 and H7. These results indicate that the effectiveness of the management system and strong commitment from top management play a direct role in improving sustainable performance. The implementation of innovative accounting tools such as the Balanced Scorecard (BSC) and Activity-Based Costing (ABC) enables organizations to integrate economic, environmental, and social dimensions into the performance measurement system, resulting in a more comprehensive and strategic decision-making process. A structured, data-driven management system helps in detecting inefficiencies, optimizing resource allocation, and designing long-term strategies that align with sustainability principles. Meanwhile, support from top management serves as a strategic enabler that not only ensures the provision of adequate resources but also fosters an organizational culture oriented towards innovation, accountability, and sustainability responsibility. Visionary leadership strengthens the implementation of sustainable management practices through the formulation of a strategic vision, development of human resource capacity, and improvement of organizational governance quality. In line with previous empirical findings, organizations with solid management systems and consistent leadership support demonstrate more resilient and adaptive performance to external environmental dynamics. Therefore, the synergy between innovative management tools and top leadership commitment is a fundamental foundation for achieving sustainable performance that encompasses economic, environmental, and social aspects in an integrated manner ([Ning et al., 2022](#)).

The mediation test results indicate that digital transformation mediates the relationships between the independent variables and sustainable performance (Y). The corrected VAF values are 38.3% for $X_1 \rightarrow M \rightarrow Y$, 37.7% for $X_2 \rightarrow M \rightarrow Y$, and 39.3% for $X_3 \rightarrow M \rightarrow Y$, all falling in the 20–80% partial-mediation range. These values indicate that approximately two-fifths of the total effect of each managerial variable is transmitted through digital transformation, while the remaining direct effects remain statistically significant and substantive. This finding is consistent with the theoretical framework positioning digital transformation as a reinforcing mechanism: it amplifies the effectiveness of management practices on sustainable performance but does not fully replace their direct influence. In the context of manufacturing SMEs, these results confirm that digitalization plays a meaningful but partial mediating role, and that sustainable performance still requires synergy between managerial capabilities, accounting system innovation, and visionary leadership. Digital transformation should therefore be viewed as a complementary component within the organizational management ecosystem, and a holistic approach integrating technology, systems, and leadership is key to achieving optimal sustainability ([Niu et al., 2022](#)).

The results also confirm that digital transformation acts not only as a mediator but as a strengthening factor in the effectiveness of management practices: SMEs that implement EMA and innovative accounting tools benefit most when supported by adequate digitalization. Digitalization enables real-time tracking of emissions and resource use through IoT and environmental dashboards, while innovative tools such as ABC and the Balanced Scorecard become more effective when integrated with ERP or digital analytics systems that support continuous, multidimensional performance monitoring. The influence of digital transformation on SME performance is therefore increasingly significant when accompanied by strong managerial capabilities, confirming a synergistic effect in which digital transformation is best viewed as a mutually reinforcing element of established managerial practice rather than a stand-alone tool ([Khalil et al., 2022](#)).

Overall, the findings provide strong empirical evidence that sustainable performance depends heavily on integrating management practices, top management support, and digital transformation. The success of digitalization is determined less by technology adoption alone than by the organization's ability to embed that technology within established management systems. For manufacturing SMEs, this integration creates strategic synergy among operational efficiency, environmental accountability, and sustainable innovation, supporting economic, social, and environmental performance simultaneously. A holistic approach combining technology, management systems, and visionary leadership is thus the main foundation for SMEs to build resilience, adaptability, and long-term competitiveness in the dynamic era of digital transformation ([H. Zhang & Dong, 2023](#)).

Viewed in terms of effect magnitude, the three managerial antecedents exert positive and meaningful influences on digital transformation. Environmental management accounting (X1) shows a moderate effect ($\beta = 0.38$), indicating that a more effective environmental accounting system strengthens the firm's drive to adopt and integrate digital technology for managing and reporting environmental data ([S. Wu et al., 2024](#)). Innovative management accounting tools (X2) exert a strong effect ($\beta = 0.42$), as modern instruments such as the balanced scorecard and activity-based costing encourage information-system integration and the digitalization of managerial processes, thereby acting as a catalyst that accelerates digital adoption ([Zhu et al., 2022](#)).

Top management support (X3) records the strongest effect on digital transformation ($\beta = 0.51$), confirming that executive commitment, resource provision, strategic direction, and an adaptive organizational culture are decisive for effective and sustainable digitalization ([Wang et al., 2022](#)). Digital transformation, in turn, exerts a strong effect on sustainable performance ($\beta = 0.47$), since digital technology improves operational efficiency, innovation capacity, and transparency, simultaneously strengthening the economic, environmental, and social dimensions of sustainability in the SME sector ([Chierici et al., 2021](#)).

With respect to direct effects on sustainable performance, environmental management accounting (X1) shows a moderate effect ($\beta = 0.29$), helping SMEs minimize waste, raise resource efficiency, and strengthen operational sustainability ([Yu et al., 2022](#)), while innovative management accounting tools (X2) show a

moderate-to-strong effect ($\beta = 0.33$) by improving the quality of strategic decision-making and thus overall organizational performance ([Tuyen et al., 2023](#)).

Top management support (X3) likewise shows a strong direct effect on sustainable performance ($\beta = 0.37$), reflecting the crucial role of executive commitment in driving sustainability strategies through resource provision, policy direction, and a sustainability-oriented culture ([Chwiłkowska-Kubala et al., 2023](#)). Finally, digital transformation positively mediates the relationships between the antecedents and sustainable performance, with indirect effects ranging from 0.18 to 0.24, indicating partial mediation in which the direct effects of the antecedents remain significant alongside the mediated pathways ([Y. Wu et al., 2024](#)).

Top management support emerged as the most influential driver of digital transformation ($\beta = 0.51$), consistent with prior studies that highlight executive commitment in establishing strategic direction, allocating resources, and building an adaptive culture that sustains the digitalization process ([Garmaki et al., 2023](#)). This dominant role may, however, vary across firm-size sub-groups: micro-enterprises (5–9 employees) may depend more heavily on owner-driven commitment, while medium enterprises (20–99 employees) may benefit from more formalized leadership structures. Future research should examine whether firm size moderates the relationship between top management support and digital transformation.

The results of this study indicate that digital transformation plays a significant role as a mediator in the relationship between management practices and sustainable performance, although the mediation is partial. This indicates that environmental management accounting and innovative accounting tools not only directly influence sustainable performance but also enhance its achievement by strengthening the organization's digital capabilities. This finding aligns with the view that digital technology functions not merely as an operational instrument but as a reinforcing factor that increases the effectiveness of management systems in achieving an organization's strategic objectives sustainably ([Guan et al., 2022](#)).

Overall, these findings provide strategic implications for SME managers: comprehensive integration of accounting systems, management commitment, and digital strategy is a key prerequisite for achieving sustainable success. An approach focused solely on technology without being balanced by strengthening a robust management system has the potential to yield limited effectiveness. Conversely, the implementation of environmental management accounting (EMA) and innovative accounting tools will yield more optimal results when supported by a comprehensive and well-planned digital transformation ([Fan et al., 2023](#)).

CONCLUSION

This study confirms that digital transformation partially mediates the relationship between environmental management accounting (VAF = 38.3%), innovative accounting tools (VAF = 37.7%), and top management support (VAF = 39.3%) on the sustainable performance of Indonesian manufacturing SMEs. All ten hypotheses are supported, with top management support emerging as the strongest antecedent of digital transformation ($\beta = 0.51$). These findings align with RBV and Dynamic Capabilities Theory: EMA, innovative tools, and managerial commitment function as VRIN resources whose value is amplified – but not entirely explained –

through digital capability. For practice, SME managers should integrate environmental accounting and modern management instruments with digital investment, supported by visionary leadership. Policymakers are encouraged to subsidize ERP and environmental dashboard access for manufacturing SMEs, develop digital sustainability reporting templates, and prioritize capacity-building in provinces with lower digital penetration.

This study has three primary limitations. First, restricting antecedents to three variables may omit other contextually relevant factors, such as organizational readiness or access to digital financing. Second, the cross-sectional design precludes causal inference about change trajectories; longitudinal or panel data would strengthen temporal conclusions. Third, single-source, self-report data introduces common method variance risk, though Harman's test results (32.7%) suggest this is not critical. Future research should incorporate multi-source data, expand to service SMEs, and replicate the model in other developing-economy contexts to broaden generalizability.

REFERENCES

- AlMulhim, A. F. (2021). Smart supply chain and firm performance: The role of digital technologies. *Business Process Management Journal*, 27(5), 1353–1372. <https://doi.org/10.1108/BPMJ-12-2020-0573>
- Anwar, M., Scheffler, M. A., & Clauss, T. (2024). Digital capabilities, their role in business model innovativeness, and the internationalization of SMEs. *IEEE Transactions on Engineering Management*, 71, 4131–4143. <https://doi.org/10.1109/TEM.2022.3229049>
- Arias-Pérez, J., Coronado-Medina, A., & Perdomo-Charry, G. (2022). Big data analytics capability as a mediator in the impact of open innovation on firm performance. *Journal of Strategy and Management*, 15(1), 1–15. <https://doi.org/10.1108/JSMA-09-2020-0262>
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120. <https://doi.org/10.1177/014920639101700108>
- Belhadi, A., Kamble, S., Gunasekaran, A., & Mani, V. (2022). Analyzing the mediating role of organizational ambidexterity and digital business transformation on Industry 4.0 capabilities and sustainable supply chain performance. *Supply Chain Management: An International Journal*, 27(6), 696–711. <https://doi.org/10.1108/SCM-04-2021-0152>
- Chierici, R., Tortora, D., Del Giudice, M., & Quacquarelli, B. (2021). Strengthening digital collaboration to enhance social innovation capital: An analysis of Italian small innovative enterprises. *Journal of Intellectual Capital*, 22(3), 610–632. <https://doi.org/10.1108/JIC-02-2020-0058>
- Chwiłkowska-Kubala, A., Cyfert, S., Malewska, K., Mierzejewska, K., & Szumowski, W. (2023). The impact of resources on digital transformation in energy sector companies. The role of readiness for digital transformation. *Technology in Society*, 74, 102315. <https://doi.org/10.1016/j.techsoc.2023.102315>
- Enrique, D. V., Lerman, L. V., Sousa, P. R. de, Benitez, G. B., Bigares Charrua Santos, F. M., & Frank, A. G. (2022). Being digital and flexible to navigate the storm: How digital transformation enhances supply chain flexibility in turbulent

- environments. *International Journal of Production Economics*, 250, 108668. <https://doi.org/10.1016/j.ijpe.2022.108668>
- Fan, M., Liu, J., Tajeddini, K., & Khaskheli, M. B. (2023). Digital technology application and enterprise competitiveness: The mediating role of ESG performance and green technology innovation. *Environment, Development and Sustainability*, 27(9), 21195–21225. <https://doi.org/10.1007/s10668-023-03979-3>
- Garmaki, M., Gharib, R. K., & Boughzala, I. (2023). Big data analytics capability and contribution to firm performance: The mediating effect of organizational learning on firm performance. *Journal of Enterprise Information Management*, 36(5), 1161–1184. <https://doi.org/10.1108/JEIM-06-2021-0247>
- Guan, H., Guo, B., & Zhang, J. (2022). Study on the impact of the digital economy on the upgrading of industrial structures: Empirical analysis based on cities in China. *Sustainability*, 14(18), 11378. <https://doi.org/10.3390/su141811378>
- Khalil, M., Khawaja, K. F., & Sarfraz, M. (2022). The adoption of blockchain technology in the financial sector during the era of fourth industrial revolution: A moderated mediated model. *Quality & Quantity*, 56(4), 2435–2452. <https://doi.org/10.1007/s11135-021-01229-0>
- Li, T., Wen, J., Zeng, D., & Liu, K. (2022). Has enterprise digital transformation improved the efficiency of enterprise technological innovation? A case study on Chinese listed companies. *Mathematical Biosciences and Engineering*, 19(12), 12632–12654. <https://doi.org/10.3934/mbe.2022590>
- Li, Y., Sun, H., Li, D., Song, J., & Ding, R. (2022). Effects of digital technology adoption on sustainability performance in construction projects: The mediating role of stakeholder collaboration. *Journal of Management in Engineering*, 38(3). [https://doi.org/10.1061/\(ASCE\)ME.1943-5479.0001040](https://doi.org/10.1061/(ASCE)ME.1943-5479.0001040)
- Ning, J., Yin, Q., & Yan, A. (2022). How does the digital economy promote green technology innovation by manufacturing enterprises? Evidence from China. *Frontiers in Environmental Science*, 10. <https://doi.org/10.3389/fenvs.2022.967588>
- Niu, S., Park, B. I., & Jung, J. S. (2022). The effects of digital leadership and ESG management on organizational innovation and sustainability. *Sustainability*, 14(23), 15639. <https://doi.org/10.3390/su142315639>
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903. <https://doi.org/10.1037/0021-9010.88.5.879>
- Sandberg, J., Holmström, J., & Lyytinen, K. (2020). Digitization and phase transitions in platform organizing logics: Evidence from the process automation industry. *MIS Quarterly*, 44(1), 129–154. <https://doi.org/10.25300/MISQ/2020/14520>
- Senadjki, A., Au Yong, H. N., Ganapathy, T., & Ogbeibu, S. (2024). Unlocking the potential: The impact of digital leadership on firms' performance through digital transformation. *Journal of Business and Socio-Economic Development*, 4(2), 161–177. <https://doi.org/10.1108/JBSED-06-2023-0050>
- Shehadeh, M., Almohtaseb, A., Aldehayyat, J., & Abu-AlSondos, I. A. (2023). Digital transformation and competitive advantage in the service sector: A moderated-

- mediation model. *Sustainability*, 15(3), 2077. <https://doi.org/10.3390/su15032077>
- Singh, S., Sharma, M., & Dhir, S. (2021). Modeling the effects of digital transformation in Indian manufacturing industry. *Technology in Society*, 67, 101763. <https://doi.org/10.1016/j.techsoc.2021.101763>
- Su, Y., & Wu, J. (2024). Digital transformation and enterprise sustainable development. *Finance Research Letters*, 60, 104902. <https://doi.org/10.1016/j.frl.2023.104902>
- Sui, B., & Yao, L. (2023). The impact of digital transformation on corporate financialization: The mediating effect of green technology innovation. *Innovation and Green Development*, 2(1), 100032. <https://doi.org/10.1016/j.igd.2022.100032>
- Sun, Y. (2024). Digital transformation and corporates' green technology innovation performance: The mediating role of knowledge sharing. *Finance Research Letters*, 62, 105105. <https://doi.org/10.1016/j.frl.2024.105105>
- Tan, L., Yang, Z., Irfan, M., Ding, C. J., Hu, M., & Hu, J. (2024). Toward low-carbon sustainable development: Exploring the impact of digital economy development and industrial restructuring. *Business Strategy and the Environment*, 33(3), 2159–2172. <https://doi.org/10.1002/bse.3584>
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509–533. [https://doi.org/10.1002/\(SICI\)1097-0266\(199708\)18:7<509::AID-SMJ882>3.0.CO;2-Z](https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z)
- Torrent-Sellens, J., Ficapal-Cusí, P., & Enache-Zegheru, M. (2023). Boosting environmental management: The mediating role of Industry 4.0 between environmental assets and economic and social firm performance. *Business Strategy and the Environment*, 32(1), 753–768. <https://doi.org/10.1002/bse.3173>
- Tsou, H.-T., & Chen, J.-S. (2023). How does digital technology usage benefit firm performance? Digital transformation strategy and organisational innovation as mediators. *Technology Analysis & Strategic Management*, 35(9), 1114–1127. <https://doi.org/10.1080/09537325.2021.1991575>
- Tuyen, B. Q., Phuong Anh, D. V., Mai, N. P., & Long, T. Q. (2023). Does corporate engagement in social responsibility affect firm innovation? The mediating role of digital transformation. *International Review of Economics & Finance*, 84, 292–303. <https://doi.org/10.1016/j.iref.2022.11.005>
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889–901. <https://doi.org/10.1016/j.jbusres.2019.09.022>
- Wang, X., Sun, X., Zhang, H., & Xue, C. (2022). Digital economy development and urban green innovation capability: Based on panel data of 274 prefecture-level cities in China. *Sustainability*, 14(5), 2921. <https://doi.org/10.3390/su14052921>
- Wu, S., Cheng, P., & Yang, F. (2024). Study on the impact of digital transformation on green competitive advantage: The role of green innovation and government regulation. *PLOS ONE*, 19(8), e0306603. <https://doi.org/10.1371/journal.pone.0306603>

- Wu, S., & Li, Y. (2023). A study on the impact of digital transformation on corporate ESG performance: The mediating role of green innovation. *Sustainability*, 15(8), 6568. <https://doi.org/10.3390/su15086568>
- Wu, W., Wang, S., Jiang, X., & Zhou, J. (2023). Regional digital infrastructure, enterprise digital transformation and entrepreneurial orientation: Empirical evidence based on the Broadband China strategy. *Information Processing & Management*, 60(5), 103419. <https://doi.org/10.1016/j.ipm.2023.103419>
- Wu, Y., Li, H., Luo, R., & Yu, Y. (2024). How digital transformation helps enterprises achieve high-quality development? Empirical evidence from Chinese listed companies. *European Journal of Innovation Management*, 27(8), 2753–2779. <https://doi.org/10.1108/EJIM-11-2022-0610>
- Xu, G., Hou, G., & Zhang, J. (2022). Digital sustainable entrepreneurship: A digital capability perspective through digital innovation orientation for social and environmental value creation. *Sustainability*, 14(18), 11222. <https://doi.org/10.3390/su141811222>
- Yang, G., Nie, Y., Li, H., & Wang, H. (2023). Digital transformation and low-carbon technology innovation in manufacturing firms: The mediating role of dynamic capabilities. *International Journal of Production Economics*, 263, 108969. <https://doi.org/10.1016/j.ijpe.2023.108969>
- Yao, Q., Tang, H., Liu, Y., & Boadu, F. (2024). The penetration effect of digital leadership on digital transformation: The role of digital strategy consensus and diversity types. *Journal of Enterprise Information Management*, 37(3), 903–927. <https://doi.org/10.1108/JEIM-09-2022-0350>
- Yousaf, Z., Radulescu, M., Sinisi, C. I., Serbanescu, L., & Păunescu, L. M. (2021). Towards sustainable digital innovation of SMEs from the developing countries in the context of the digital economy and frugal environment. *Sustainability*, 13(10), 5715. <https://doi.org/10.3390/su13105715>
- Yu, J., Wang, J., & Moon, T. (2022). Influence of digital transformation capability on operational performance. *Sustainability*, 14(13), 7909. <https://doi.org/10.3390/su14137909>
- Yuan, Y., Tan, H., & Liu, L. (2024). The effects of digital transformation on supply chain resilience: A moderated and mediated model. *Journal of Enterprise Information Management*, 37(2), 488–510. <https://doi.org/10.1108/JEIM-09-2022-0333>
- Zhang, H., & Dong, S. (2023). Digital transformation and firms' total factor productivity: The role of internal control quality. *Finance Research Letters*, 57, 104231. <https://doi.org/10.1016/j.frl.2023.104231>
- Zhang, H., Wu, J., Mei, Y., & Hong, X. (2024). Exploring the relationship between digital transformation and green innovation: The mediating role of financing modes. *Journal of Environmental Management*, 356, 120558. <https://doi.org/10.1016/j.jenvman.2024.120558>
- Zhang, X., Xu, Y. Y., & Ma, L. (2023). Information technology investment and digital transformation: The roles of digital transformation strategy and top management. *Business Process Management Journal*, 29(2), 528–549. <https://doi.org/10.1108/BPMJ-06-2022-0254>

- Zhao, Q., Li, X., & Li, S. (2023). Analyzing the relationship between digital transformation strategy and ESG performance in large manufacturing enterprises: The mediating role of green innovation. *Sustainability*, 15(13), 9998. <https://doi.org/10.3390/su15139998>
- Zhao, Y., Song, Z., Chen, J., & Dai, W. (2023). The mediating effect of urbanisation on digital technology policy and economic development: Evidence from China. *Journal of Innovation & Knowledge*, 8(1), 100318. <https://doi.org/10.1016/j.jik.2023.100318>
- Zhou, S., Zhou, P., & Ji, H. (2022). Can digital transformation alleviate corporate tax stickiness: The mediation effect of tax avoidance. *Technological Forecasting and Social Change*, 184, 122028. <https://doi.org/10.1016/j.techfore.2022.122028>
- Zhu, J., Zhang, B., Xie, M., & Cao, Q. (2022). Digital leadership and employee creativity: The role of employee job crafting and person-organization fit. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.827057>