

Digital Business Model Transformation and MSME Performance: The Mediating Role of Green Intellectual Capital

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Abstract. This study addresses a gap in the literature by examining the impact of digital business model transformation on the performance of Micro, Small, and Medium Enterprises (MSMEs) through the mediating role of green intellectual capital. Drawing on the resource-based view and technology acceptance model, we propose a novel conceptual framework linking digital transformation, green intellectual capital, and MSME performance. Survey data from 250 batik MSMEs in Central Java, Indonesia, were analyzed using partial least squares structural equation modeling (PLS-SEM). The results indicate that digital business model transformation positively influences MSME performance, both directly and indirectly through the enhancement of green intellectual capital. These findings contribute to the literature by highlighting the importance of digital transformation and environmentally oriented intellectual capital for MSME success. Practically, the study offers insights for MSME managers and policymakers seeking to promote sustainable growth in the digital economy.

Keywords: Digital business model transformation, Green intellectual capital, MSME performance

1. Introduction

Digitalization introduces novel business models and alters consumer behavior, thereby reshaping the economic and financial landscape for countries, corporations, and Micro, Small, and Medium Enterprises (MSMEs). Rapidly embraced by communities, new business models emphasizing convenience bring forth a shift in competitive dynamics with the emergence of fresh market players. Established business entities are compelled to undergo digital transformation to navigate these changes, as consumer expectations increasingly lean towards fast, facile, and cost-effective services on digital platforms. The pivotal role of digitalization in the production of goods and services is underscored, fostering innovation and enhancing operational efficiency.

Nonetheless, as per data from the Ministry of Communication and Information in 2021, Indonesia grapples with several challenges in its digital economy landscape, notably: 1) a vulnerability in cybersecurity; 2) Internet penetration lags behind regional counterparts such as Singapore (88%), Malaysia (83%), Thailand (75%), and Vietnam (70%), standing at only 64%; 3) a deficiency in digital talents aligned with industry requirements; 4) the proliferation of e-commerce has led to an influx of imported products; and 5) Indonesia's mobile Internet speed measures at 13.83 Mbps, trailing behind Malaysia (23.8 Mbps), Thailand (25.9 Mbps), and Singapore (57.16 Mbps).

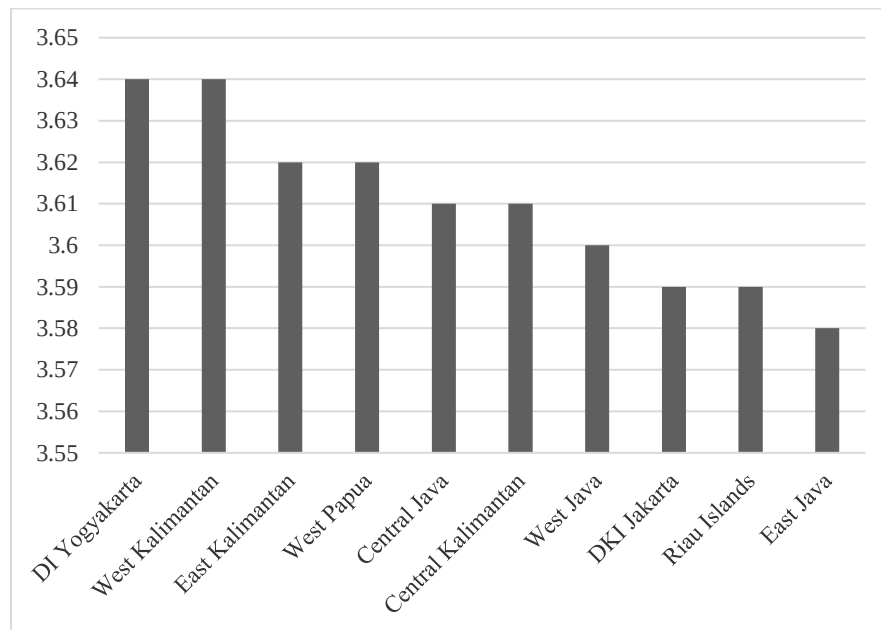


Fig. 1: Top Ten Indonesia Digital Literacy Index Rankings

Furthermore, the challenges in Indonesia's digital landscape are underscored by a 2022 survey conducted by the Ministry of Communication and Information, gauging digital literacy through indicators such as skills, ethics, safety, and culture. The findings reveal that the digital literacy of Indonesians garnered a score of 3.54 on a scale of 1-5, falling into the "medium" category. For a detailed breakdown of Indonesia's digital literacy rankings by province, based on the 2023 survey by the Ministry of Communication and Information, please refer to Fig. 1.

The data presented in Fig. 1, derived from the survey conducted by the Ministry of Information, highlights that Java, encompassing West Java, East Java, DKI Jakarta, and Central Java, serves as the economic hub with the largest population in Indonesia. Simultaneously, the literacy index indicates a need

for improvement in West Kalimantan, East Kalimantan, and West Papua, regions experiencing sluggish economic growth. The Ministry of Communication and Information's literacy survey aligns with findings from the Financial Services Authority in 2022, illustrating the persistently low levels of digital financial literacy in Indonesia when compared to financial inclusion, as illustrated in Fig. 2.

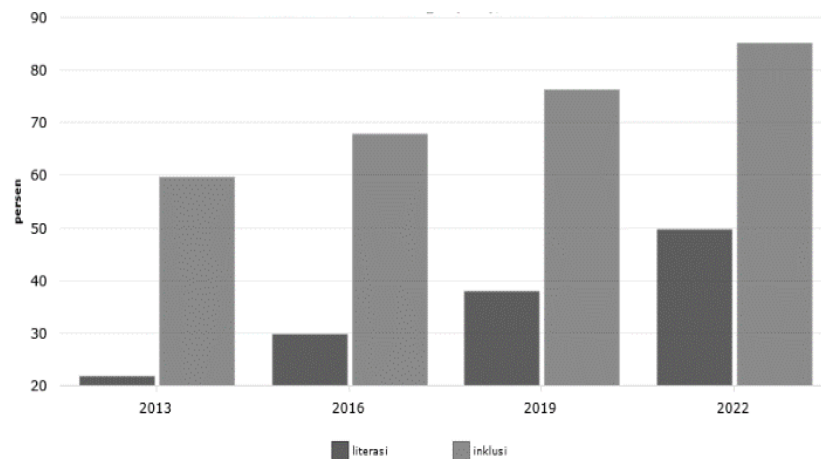


Fig. 2: Financial Literacy and Financial Inclusion Data in Indonesia

Drawing from the insights presented in Fig. 2, a substantial portion of the Indonesian populace remains in need of enhanced digital financial literacy, emphasizing the government's imperative to respond judiciously and swiftly. In light of the survey findings, it is crucial for the government to expedite educational initiatives and literacy programs while facilitating digital access to ensure swift, easy, and affordable services. This strategic response aims to amplify the impact on economic growth and enhance the welfare of the population, particularly by fortifying the performance of MSMEs. MSME stakeholders, especially in rural areas, grapple with challenges inherent in the digital age, including limited internet connectivity, inadequate hardware, and a deficit in digital skills and knowledge (Anatan & Nur, 2023; Mawarsari, 2023).

Notwithstanding these challenges, fostering the digitalization of MSMEs is imperative for the growth of Indonesia's digital economy (Mina, 2023). As of 2022, only 32% or 21 million MSMEs in Indonesia leverage digital technology, leaving a substantial 68% untapped, requiring digital technology integration for business development (Ministry of Communication and Information, 2022). Governments are thus duty-bound to champion and facilitate digital connectivity as a means to sustainably bolster the national economy.

The indispensable contributions of MSMEs to national economic growth and employment are underscored by data from the Ministry of Coordination and Economic Affairs, indicating a 60.5% contribution to GDP and employing 96.9% of the workforce nationally. This aligns with the ASEAN Investment Report 2022 from the United Nations Conference on Trade and Development, citing 65.46 million MSMEs in Indonesia contributing 60.3% to GDP and employing 97% of the workforce. In Q1 2023, Indonesia's economic growth reached 5.03% year-on-year, with an anticipated slowdown to 4.8% annually in 2023 (PwC Indonesia, 2023). The pivotal role of MSMEs in national economic recovery is evident, with approximately 117 million workers employed, over 64% of whom are female (World Bank Group, 2023). Recognizing the substantial contribution of MSMEs, the government should formulate strategic policies, particularly in the realms of financial literacy education and widespread digital financial innovation.

The nascent state of digital financial literacy in Indonesia, juxtaposed with financial inclusion, underscores the need for intensified government attention. Financial literacy is pivotal in enhancing

individuals' financial inclusion and security, enabling them to assess their needs effectively and plan for the future. Given the current conventional conceptualization of financial literacy, its evolution is imperative, necessitating a shift toward a digitally-centric approach (Lyons & Kass-Hanna, 2021), especially for MSMEs. Access to digital finance is deemed essential for MSMEs to achieve financial literacy (Frimpong, Agyapong, & Agyapong, 2022). MSMEs stand to gain significantly from the intersection of financial literacy and digital technology in economic development (Mabula & Ping, 2018) and overall economic growth (Rastogi, Panse, Sharma, & Bhimavarapu, 2021).

Research findings from Kulathunga, Ye, Sharma, and Weerathunga (2020) and Ratnawati and Soelton (2022) posit a positive correlation between financial literacy and MSME performance. Additionally, Dura (2022) and Mutamimah and Indriastuti (2023) highlight a significant positive impact of financial literacy on MSME performance. However, it is noteworthy that digital literacy and fintech do not moderate the relationship between financial literacy and MSME performance, as evidenced by research results from the study by Dura (2022) and Mutamimah and Indriastuti (2023).

To address the ongoing challenge faced by the government in facilitating efficient access for the community, particularly MSMEs, digital financial innovation plays a crucial role. This innovation significantly impacts the sustainability of MSMEs (Ullah et al., 2022). Through involvement in the digital ecosystem, financial innovation brings added value to the financial services sector by updating business models, processes, and instruments (POJK No 13/POJK.02/2018). Adopting a collaborative approach, digital financial innovation aims to offer community services efficiently and swiftly through digital technology, contributing to the national economy. Strategies involving digital financial innovation have the potential to enhance global economic performance (Umadia Sr. & Kasztelnik, 2020).

By providing easy access to essential activities such as disbursements, payments, deposits, withdrawals, and remittances, financial innovation minimizes errors or irregularities (Fernandes et al., 2014). As of January 2023, there are 15 types of digital financial innovation services offered by 102 companies in Indonesia (Otoritas Jasa Keuangan, 2023). However, research by Mutamimah and Indriastuti (2023) on Indonesian MSMEs suggests that familiarity and understanding of these services, especially within the MSME sector, need improvement. In contrast, Effiom and Edet's (2022) study on Nigerian MSMEs reveals a positive impact of digital innovations on performance.

To address the gap in digital financial literacy and innovation in Indonesia, this research proposes a novel concept – a green intellectual capital model based on digital transformation. Recognizing the significance of green intellectual capital for MSME sustainability (Ullah et al., 2022), this model integrates human, organizational, and relational factors to promote success in green process innovation (Jirakraisiri et al., 2021). Intellectual capital, defined as intangible assets and activities transforming physical, financial, and human resources, has been shown to positively impact MSME performance (Hidayat et al., 2022; Demartini & Beretta, 2020; Orba et al., 2020).

The synthesis of green intellectual capital with digital transformation responds to the need for MSMEs to be competitive through business digitization. Digital transformation, extending beyond mere digitalization, enhances innovation performance by improving human, structural, and relational dimensions of intellectual capital (Mubarra et al., 2023). Sustainability is crucial for businesses, including SMEs, and achieving it through digital transformation is emphasized (Martínez-Peláez et al., 2023). Empirical research by Mubarak et al. (2019), Teng et al. (2022), and Ying-Yu et al. (2016) confirms the significant positive effect of digital transformation on MSME performance.

For businesses, especially MSMEs, sustainability through digital transformation is essential (Fabian, Broekhuizen, & Nguyen, 2021). Empirical evidence supports the notion that the synthesis of green intellectual capital and digital transformation can enhance MSME performance. Thus, the proposed "Green

Intellectual Capital Based on Digital Transformation" model offers a potential avenue for optimizing MSME performance.

Focusing specifically on batik MSMEs in Central Java, these enterprises face challenges in financial and capital management, production, human resources, marketing, technological knowledge, and business partnerships. Limited access to financial institutions further compounds these issues (Kurniawan & Kodir, 2015; Fristia & Navastara, 2014; Susanty et al., 2012). Given the economic and cultural importance of batik MSMEs, further research is imperative to address these challenges and contribute to preserving national heritage while supporting the economy.

2. Literature Review

2.1. Green Intellectual Capital Based on Digital Transformation

The conceptual framework of this study, introducing the innovative concept of green intellectual capital based on digital transformation, draws on the foundational principles of the resource-based view (RBV). The RBV, pioneered by Wernerfelt (1984), Barney (1991), and Grant (1991), asserts that companies seeking a competitive advantage must leverage their internal strengths, comprising resources and capabilities, to capitalize on opportunities, mitigate environmental threats, and address internal weaknesses. Effective and efficient utilization of a company's resources and capabilities is paramount for sustaining a competitive advantage.

Sustainable competitive advantage, as suggested by the RBV theory, is achieved through the utilization of valuable and inimitable firm resources and capabilities (Liu et al., 2022). Green intellectual capital, encompassing competencies, proficiencies, and aptitudes related to environmental sustainability, plays a crucial role in fostering green innovation and environmental performance (Liu et al., 2022; Khanra et al., 2021; Asiaei et al., 2021). Within the context of MSMEs, the RBV literature posits that firm performance is contingent upon the effective amalgamation of resources and capabilities (Ramón-Jerónimo et al., 2019). The relevance of RBV theory and the concept of green intellectual capital lies in their ability to elucidate how organizations, including MSMEs, can leverage their resources and capabilities for sustainable competitive advantage and enhanced environmental performance.

Furthermore, Estensoro et al. (2022) offer a framework grounded in the resource-based view, facilitating the application of Industry 4.0 in SMEs with careful consideration given to the stage of development. Teng et al.'s (2022) research investigates the impact of SMEs' resources, including digital technology, on digital transformation. The resource-based perspective posits that successful companies possess resources augmenting their competitive advantage. The integration of digital transformation is employed to reshape the business strategies of SMEs, with particular relevance observed in the context of women's MSMEs in Indonesia (Susanti et al., 2023). This combined research underscores the significance of the resource-based view in comprehending the effects of digital business model transformation on the performance of MSMEs, particularly within the context of Industry 4.0 and the drivers of digital export.

The second theoretical foundation of this study is the Technology Acceptance Model (TAM), developed by Davis (1985). TAM posits that perceived usefulness and ease of use are pivotal factors influencing individual acceptance of an information technology system. These factors, in turn, significantly impact behavioral intention, as users are more inclined to adopt a system if they perceive it as valuable and easy to use.

TAM has found application in studying the adoption of digital technology among Small and Medium Enterprises (SMEs). Research findings suggest that digital finance and the acceptance of technology play influential roles in SME performance (Thathsarani & Jian-Guo, 2022). By combining variables such as

perceived usefulness and ease of use, the model seeks to clarify and predict the adoption of technology by users (Susanti & Astuti, 2019). Thathsarani and Jian-Guo (2022) provide evidence that the use of digital technology by SMEs can lead to improved financial inclusion and enhanced SME performance. This context is particularly relevant for digital business model transformation, where technology adoption contributes to the growth and success of MSMEs (Singh, 2022). The Technology Acceptance Model (TAM) has proven instrumental in understanding the adoption of digital technology within SMEs and its impact on their performance, especially in the context of digital business model transformation.

Moreover, TAM has been employed to investigate the acceptance and adoption of information management systems, while the Resource-Based View (RBV) has been utilized to examine the role of organizational resources in achieving competitive advantage (Opoku & Enu-Kwesi, 2020; Ramkumar et al., 2019). The significance of TAM and RBV in comprehending the adoption and utilization of technology within organizations has been underscored in prior research, as noted by Nahar (2022). Both the Resource-Based View and the Technology Acceptance Model serve as crucial theoretical frameworks in this study, offering insights into the role of organizational resources and user acceptance in achieving competitive advantage and successful technology adoption.

2.2. Digital Business Model Transformation

The theory of business models serves as an effective predictor of the future use of digital technology (Climent & Haftor, 2021). Central to maintaining and enhancing competitiveness, growth, innovation, and profitability is the concept of Digital Business Model Transformation (Klotzer & Pflaum, 2017). This transformation involves the integration of digital technology into business processes with the aim of improving performance and generating new business models (Vaska et al., 2021). The integration of digital technology into business processes is geared towards increasing profitability, consolidating products and services across functional, organizational, and geographic boundaries, and sustaining competitiveness in the digital era (Vaska et al., 2021; Teoh et al., 2022).

In essence, the process of digital transformation opens up opportunities for creating novel business models while simultaneously optimizing, simplifying, and rationalizing existing processes (Furr et al., 2022). This strategic shift towards Digital Business Model Transformation is recognized as the principal pathway for businesses to thrive in a dynamic and digital landscape, emphasizing the importance of integrating digital technology into core business operations for improved overall performance.

2.3. MSME Performance

The term "firm performance" encompasses various facets of a firm's operations, including organizational performance, functions, and operating results (Taouab & Issor, 2019). When applied to MSMEs, performance refers to how well these businesses are faring in terms of achieving their goals and objectives. The enhancement of MSME performance holds significant importance as a catalyst for innovation (Sijuang et al., 2022), long-term sustainability and the broader economy (Budiarto et al., 2021), productivity (Yuningsih et al., 2022), and the welfare of MSMEs (Alansori & Listyaningsih, 2022).

3. Hypotheses Development

3.1. Digital Business Model Transformation and MSME Performance

Digital business model transformation plays a central role in leveraging the commercial potential of digital technology, making the design of a suitable digital business model a crucial prerequisite for achieving superior company performance (Fernández-Portillo et al., 2022). This transformative process has emerged as a key driver of business innovation, offering enterprises new opportunities to innovate and create value (Wang et al., 2023). Digital business models, characterized by innovation-based architectures that are

challenging to imitate, tend to provide the long-term competitive advantages necessary for enhancing company performance (Vendrell-Herrero, Parry, Bustinza, & Gomes, 2018).

For MSMEs, digital transformation brings forth numerous benefits, including process optimization, increased operational efficiency, improved productivity, cost reduction, market expansion, and enhanced customer satisfaction. These advantages collectively contribute to an overall improvement in business performance (Asia-Pacific Economic Cooperation, 2023). The empirical findings of Heubeck (2023) underscore that digital business model transformation significantly and positively influences company performance. This aligns with the perspectives of Sawy and Pereira (2013) and Verhoef and Bijmolt (2019), supporting the notion that digital business model transformation leads to enhanced company performance, reinforcing the imperative of integrating such transformations for organizational survival.

H1: Digital business model transformation has a significant positive impact on MSME performance.

3.2. Digital Business Model Transformation and Green Intellectual Capital

A business model is instrumental in shaping how intellectual capital is both created and utilized within a company (Ujwary-Gil, 2017; Sylwia, 2021). The incorporation of digital transformation into business models enables companies to optimize their operations and processes, as emphasized by Genzorová et al. (2019). Pirogova et al. (2020) contend that the impact of digital solutions on the formation and utilization of intellectual capital in service sector companies positively enhances efficiency. Additionally, Alekseeva et al. (2020) identify that the digital transformation of intellectual capital within industrial clusters has innovative effects on the overall value of intellectual capital.

The intricate interplay between intellectual capital and digital transformation extends beyond efficiency gains. It has been shown to bolster innovation performance (Shabbir et al., 2023) and exert a positive influence on sustainable accounting practices (Izzo et al., 2021). In a study by Feng et al. (2022), a thorough empirical analysis of the impact of corporate digital transformation on green innovation revealed significant findings. The results underscored that a company's digital transformation significantly fosters green innovation, representing a manifestation of what can be termed as green intellectual capital.

H2: Digital business model transformation has a significant positive impact on green intellectual capital.

3.3. Green Intellectual Capital and MSME Performance

The theoretical foundation of this research centers around the innovative concept of green intellectual capital based on digital transformation, which represents a synthesis of green intellectual capital grounded in the theory of the resource-based view (RBV) and digital transformation based on the theory of the technology acceptance model (TAM). Drawing inspiration from previous studies, this research builds upon the findings of Hidayat et al. (2022), who investigated the influence of intellectual capital on the performance of MSMEs, specifically in flagship clusters such as batik, fish processing, and coffee clusters in Rembang Regency. Their results demonstrated that intellectual capital plays a pivotal role in enhancing MSME performance, aligning with the conclusions of Demartini and Beretta (2020), who observed a significant positive effect of intellectual capital on MSME performance in European contexts.

Moreover, Rustiarini et al. (2022) provided empirical evidence that green intellectual capital positively contributes to green innovation, SME sustainability, and financial performance. Their study revealed that green innovation, propelled by green intellectual capital, enhances the competitive advantage of SMEs. In the realm of digital transformation and its impact on MSME performance, research conducted by Mubarak et al. (2019) in Pakistan, Teng et al. (2022) in China, and Ying-Yu et al. (2016) in Taiwan collectively found that digital transformation significantly improves MSME performance. Emphasizing the integration

of sustainable practices through digital transformation, Martínez-Peláez et al. (2023) highlighted that this approach empowers MSMEs to drive innovation, reduce costs, and enhance their reputation.

H3: Green intellectual capital has a significant positive impact on MSME performance.

3.4. Digital Business Model Transformation, Green Intellectual Capital, and MSME Performance

Currently, no direct research has explored the impact of green intellectual capital based on digital transformation as a mediating variable in the relationship between business models and the performance of MSMEs. However, existing studies delve into digital transformation, intellectual capital, and innovation concerning MSME performance.

Digital business model transformation involves the adoption of digital technology to fundamentally reshape the operational framework of businesses. Melo et al. (2023) observed that digital transformation goes beyond digitization, completely overhauling companies and giving rise to innovative business models.

Green intellectual capital, referring to intellectual assets related to the environment and sustainability, has been shown in several studies to impact company performance, encompassing environmental and financial dimensions. MSMEs with robust green intellectual capital are better positioned to face economic challenges (N. Chaudhry & M. Chaudhry, 2022), compete effectively in the market (Chen, 2007), and exhibit a higher propensity for long-term survival and growth (Omar et al., 2017). However, there is a need for more research explicitly examining how green intellectual capital influences the transformation of digital business models and, consequently, MSME performance.

Yusoff et al. (2019) conducted a study demonstrating the positive impact of green intellectual capital on business sustainability. Additionally, research by Yusliza et al. (2020) indicates that green intellectual capital positively influences sustainable performance. Thus, green intellectual capital holds the potential to influence the transformation of digital business models, especially in the environmental context, affecting MSME performance.

As of now, no studies have explored the interconnectedness of digital business model transformation, green intellectual capital resulting from digital transformation, and the performance of MSMEs. MSMEs successfully transforming their business models using digital technology may be better positioned to compete in the market and enhance their performance, particularly in terms of improving intellectual capital and organizational resilience. Moreover, managing environmentally friendly intellectual capital emerges as an essential aspect of digital business model transformation for MSMEs.

H4: Digital business model transformation has a significant positive impact on MSME performance through green intellectual capital.

4. Methodology

4.1. Sample and Data Collection

This research focused on batik Small and Medium Enterprises (SMEs) in Central Java, specifically in Pekalongan, Surakarta, Rembang, and Purbalinga. Pekalongan was chosen for its unique blend of Chinese, Malay, Japanese, Dutch, and Arabic cultural influences on batik. Surakarta was selected due to the significant impact of the Solo Palace on its batik industry, while Rembang was chosen for its distinctive combination of Javanese and Chinese cultural elements in batik designs. Purbalinga, known for Banyumas batik, was selected for its use of natural colors, the double-sided batik process, and nature-themed motifs.

These regions showcase unique aspects, representing both Pantura and South-Central Java. The total number of batik SMEs in these four regions is 1,353. Proportional cluster sampling was employed to select samples from each location, resulting in the collection of 250 samples through interviews and

questionnaires. This sample size aligns with the recommended minimum for Structural Equation Modeling (SEM), ranging from 100 to 200 (Hair Jr, Black, Babin, & Anderson, 2018). Detailed information on the number of samples from each district/city is provided in Table 1.

Table 1: Determination of the Sample Selections

Number	District/City	Population	Proportion	Samples
1.	Pekalongan	878	64.89%	162
2.	Surakarta	232	17.15%	43
3.	Rembang	120	8.87%	22
4.	Purbalingga	123	9.09%	23
Total		1.353		250

4.2. Variables and Measures

The approach of Structural Equation Modeling (SEM) with Partial Least Square (PLS) was adopted in this study. The measurement of all variables is observable in Table 2.

Table 2: Variable Measurement

Variable	Indicator	Reference
Digital business model transformation	1. Value proposition (2 question items)	
	2. Revenue sources (2 question items)	
	3. Customer segments (2 question items)	
	4. Customer relationship (2 question items)	
	5. Marketing channels (2 question items)	
	6. Key activities (2 question items)	
	7. Key resources (2 question items)	
	8. Key partners (2 question items)	
	9. Cost structures (2 question items)	
Green intellectual capital based on digital transformation	1. Green human capital (3 question items)	Ullah et al. (2021); Hidayat et al. (2022); Li et al. (2020); Marzo & Scarpino (2016); Yaseen et al. (2016); Eller, Alford, Kallmünzer, & Peters (2020); Hidayat & Dewi, (2020); Odoom, Anning-Dorson, & Acheampong (2017); Pergelova, Manolova, Simeonova-Ganeva, & Yordanova (2019); Rita (2019)
	2. Green relation capital (4 question items)	
	3. Green structural capital (2 question items)	
	4. Use of digital platforms (3 question items)	
	5. Effectiveness of digital platforms (4 question items)	
MSME performance	1. Financial performance (3 question items)	Özbuğday, Fındık, Özcan, & Başçı (2020); Rita (2019); Rita, Hidayat, & Kristanto (2021); Hidayat et al. (2022)
	2. Market performance (3 question items)	
	3. Entrepreneurial performance (3 question items)	

5. Results

The validity of the data was tested, including two parts that must be seen, namely convergent validity and discriminant validity.

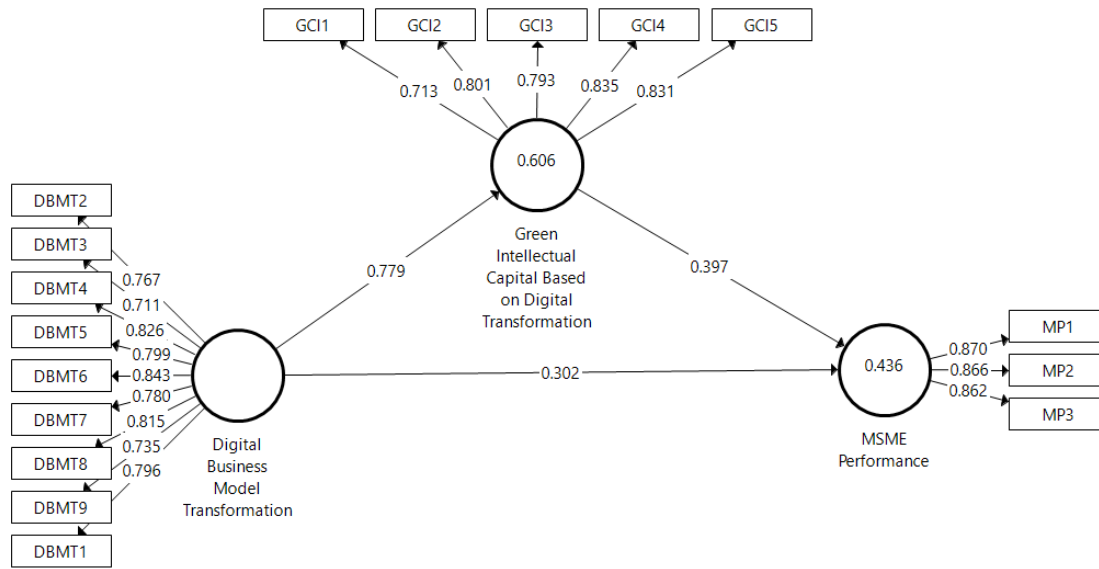


Fig. 3: Structural Model Evaluation

Table 3 shows that all indicators meet convergent validity criteria, with outer loading values above 0.60.

Table 3: Outer Model

Indicator	Digital Business Model Transformation	Green Intellectual Capital Based on Digital Transformation	MSME Performance
DBMT1	0.796		
DBMT2	0.767		
DBMT3	0.711		
DBMT4	0.826		
DBMT5	0.799		
DBMT6	0.843		
DBMT7	0.780		
DBMT8	0.815		
DBMT9	0.735		
GCI1		0.713	
GCI2		0.801	
GCI3		0.793	
GCI4		0.835	
GCI5		0.831	
MP1			0.870
MP2			0.866
MP3			0.862

Table 4: Average Variance Extracted (AVE)

Variable	Average Variance Extracted (AVE)
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Digital Business Model Transformation	0.619
Green Intellectual Capital Based on Digital Transformation	0.633
MSME Performance	0.750

Table 4 demonstrates that all constructs meet the validity criteria, with an Average Variance Extracted (AVE) value exceeding the recommended threshold of 0.50.

In Table 5, the data reveals that all variables consistently meet the necessary standard of 0.60 for both Cronbach's alpha and composite reliability values. This confirmation underscores the validity and reliability of the constructs in the study.

Table 5. Reliability

Variable	Cronbach's Alpha	Composite Reliability
Digital Business Model Transformation	0.923	0.936
Green Intellectual Capital Based on Digital Transformation	0.855	0.896
MSME Performance	0.833	0.900

Table 6: R-Square

Variable	R Square
Green Intellectual Capital Based on Digital Transformation	0.606
MSME Performance	0.436

To assess the structural model's goodness-of-fit, we examined the R-square values, as outlined in Table 6. This table sheds light on the percentage of influence exerted by independent variables on green intellectual capital, specifically considering the influence of digital transformation. The findings reveal that 60.6% of the influence on green intellectual capital can be explained by the variables considered in the study. The remaining portion is influenced by variables not accounted for in this research. Similarly, the impact of independent variables on MSME performance can be explained by 43.6%, while the remaining influence is attributed to unexamined variables.

In this study, we employed a simulation approach to conduct Partial Least Squares (PLS) statistical testing for each hypothesized relationship. The bootstrapping method was applied to the sample, utilizing data collected during the measurement stage. In the original sample, a positive value indicates a favorable influence between variables, while a negative value suggests an unfavorable inter-variable influence. The criterion for measurement integrity is set at a 5% error rate, corresponding to a t-statistic value of 1.96.

Table 7: Path Coefficients

Variable	Original Sample	Sample Mean	Standard Deviation	T-statistics	P-values
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Digital Business Model Transformation -> Green Intellectual Capital Based on Digital Transformation	0.779	0.781	0.026	29.548	0.000
Digital Business Model Transformation -> MSME Performance	0.302	0.304	0.067	4.537	0.000
Green Intellectual Capital Based on Digital Transformation -> MSME Performance	0.397	0.399	0.063	6.263	0.000

Hypothesis testing was carried out utilizing the bootstrapping technique, where a comparison of predetermined t-statistics or t-counts was performed. The critical threshold for significance was set at a one-tail t-table value of 1.96, representing a standard error of 5%, or a p-value below 0.05, as recommended by Hair Jr et al. (2018). Examining the impact of digital business model transformation on MSME performance, the original sample value displayed a positive effect of 0.302. The resulting t-statistic value of 4.537 exceeded the threshold of 1.96, and the p-value was below 0.05 (0.000), indicating a significant influence of digital business model transformation on MSME performance. Similarly, when assessing the impact of digital business model transformation on green intellectual capital based on digital transformation, the original sample value showed a positive effect of 0.779. The t-statistic value of 29.548 surpassed the threshold of 1.96, and the p-value was below 0.05 (0.000), signifying a substantial effect of digital business model transformation on green intellectual capital based on digital transformation. Furthermore, the examination of green intellectual capital based on digital transformation on MSME performance revealed an original positive sample value of 0.397. The t-statistic value of 6.263 exceeded 1.96, and the p-value was below 0.05 (0.000), demonstrating a noteworthy influence of green intellectual capital based on digital transformation on MSME performance.

Table 8: Specific Indirect Effects

Variable	Original Sample	Sample Mean	Standard Deviation	T-statistics	P-value
Digital Business Model Transformation -> Green Intellectual Capital Based on Digital Transformation -> MSME Performance	0.309	0.313	0.052	5.963	0.000

The mediation analysis examining the role of green intellectual capital based on digital transformation in mediating the influence of digital business model transformation on MSME performance revealed a positive original sample value of 0.309. The resulting t-statistic value of 5.963 exceeded the threshold of 1.96, and the p-value was below 0.05 (0.000). This signifies that green intellectual capital based on digital transformation acts as a mediator, playing a significant role in influencing the relationship between digital business model transformation and MSME performance.

6. Discussion

This research yields several key findings. Firstly, digital business model transformation has a positive impact on the performance of MSMEs. This aligns with previous studies by Sawy and Pereira (2013) and Heubeck (2023), indicating that embracing digital business model transformation enhances MSME performance. The digitization of business processes enables the creation of new value, a crucial aspect in today's digitalized society (Vaska et al., 2021). Moreover, the study highlights the significance of incorporating digitalization in the analysis of business models to maintain relevance in the evolving business landscape (Vendrell-Herrero et al., 2018). The positive effects of digitalization extend to the management of global supply chains, where digital transformation is expected to play a pivotal role (Klotzer & Pflaum, 2017). In the context of Indonesia, the incorporation of digital transformation has been shown to substantially benefit the revitalization of MSMEs (Anatan & Nur, 2023), emphasizing the need for performance measurement that encompasses digital transformation and SMEs (Melo et al., 2023).

Secondly, the research reveals that digital business model transformation significantly influences green intellectual capital based on digital transformation. The concept of green intellectual capital is linked to green innovation, with digital technologies recognized as facilitators of green innovations (Feng et al., 2022). Digital technologies play a crucial role in influencing intellectual capital elements, leading to cost reduction, sales growth, and innovation performance (Pirogova et al., 2020; Mubarra et al., 2023). The study underscores the transformative impact of digitization on intellectual capital, emphasizing its role in enhancing the efficiency of intellectual capital elements and fostering innovation in businesses (Pirogova et al., 2020; Alekseeva et al., 2020). The relationship between digital transformation and intellectual capital is deemed vital for companies striving to enhance product and process innovations (Shabbir et al., 2023).

Thirdly, green intellectual capital based on digital transformation significantly influences the performance of MSMEs. This finding aligns with prior research demonstrating that intellectual capital positively contributes to MSME performance (Absah et al., 2018; Orba et al., 2020; Hidayat et al., 2022). In the modern business environment, intangible assets, particularly intellectual capital, play a pivotal role in optimizing business effectiveness and performance (Ullah, 2022). Efficiently managing tangible and intellectual capital enhances MSME profitability and utilization of human and structural capital (Kim & Tran, 2023). The study emphasizes the foundational role of human capital in intellectual capital, highlighting its strategic importance in achieving competitive advantages and elevating performance levels (Henry, 2013). Moreover, the study stresses the need for upgrading employee skills in line with modern technology to drive innovation and enhance MSME performance (Mubarak, 2019; Rahayu, 2022).

Lastly, the research establishes that green intellectual capital based on digital transformation serves as a mediating variable between digital business model transformation and MSME performance. Acting as a mediator, green intellectual capital based on digital transformation mitigates the influence of digital business model transformation on MSME performance. This mediating role facilitates the transformation of physical, human, and financial resources into a capability system through digitalization, enhancing competitiveness and overall performance effectiveness of MSMEs.

7. Conclusion

This study contributes to the literature by proposing and empirically testing a novel conceptual framework linking digital business model transformation, green intellectual capital, and MSME performance. The findings highlight the importance of digital transformation and environmentally oriented intellectual capital as key drivers of MSME success in the context of the batik industry in Indonesia. By providing evidence of the mediating role of green intellectual capital, the study offers a more nuanced understanding of how digital transformation translates into improved performance outcomes.

Theoretically, the integration of RBV and TAM perspectives enriches our understanding of the factors that enable MSMEs to effectively leverage digital technologies for sustainable growth. The study extends prior research by demonstrating the relevance of green intellectual capital as a key resource in the digital economy, and by clarifying the mechanisms through which digital transformation influences performance.

Practically, the findings suggest that MSME managers should prioritize investments in digital technologies and the development of green intellectual capital to enhance their competitiveness. Policymakers can support these efforts by providing training, infrastructure, and financial support to facilitate digital transformation and eco-innovation among MSMEs.

However, the study is not without limitations. The cross-sectional nature of the data precludes causal inferences, and the focus on a single industry and country context may limit the generalizability of the findings. Future research should examine the proposed relationships in other settings, and use longitudinal designs to better capture the dynamics of digital transformation and MSME performance over time. Additionally, the measurement of key constructs could be refined and expanded in future studies. For example, green intellectual capital could be operationalized in a more multidimensional way, capturing aspects such as green human capital, green structural capital, and green relational capital. The use of objective measures of MSME performance, such as financial statements or third-party ratings, could also strengthen the validity of the findings. Despite these limitations, the study makes an important contribution by highlighting the role of digital transformation and green intellectual capital in driving MSME performance. It opens up new avenues for research on the intersection of digital technologies, environmental sustainability, and entrepreneurship, and provides valuable insights for practitioners seeking to navigate the challenges and opportunities of the digital economy.

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