

Digital Transformation in the Pusaka Beruang Lasem Batik Industry for Sustainable Economic Development

Imam Wahyudhi *

IAIN Fattahul Muluk Papua, Indonesia

* imamwahyudhi.234@gmail.com

ARTICLE INFO

Article history

Received May 11, 2026

Revised June 30, 2026

Accepted July 17, 2026

Keywords: Digital Transformation;
Lasem Batik; Sustainable
Economy; Cultural Heritage
Preservation; Craft MSMEs.

ABSTRACT

Traditional heritage craft industries face severe vulnerabilities in balancing cultural authenticity with modern digital market demands. This study examines the mechanisms of digital transformation within the traditional Lasem Hand-Drawn Batik industry (Batik Tulis Pusaka Beruang) and analyzes its specific contributions toward building a sustainable economic model. A descriptive qualitative case study design was employed, gathering empirical data from ten key stakeholders, including senior workshop owners, next-generation artisans, local government officials, cooperative leaders, and consumers, through in-depth interviews and field observations across active workshops in Rembang Regency. Findings reveal that digital adoption operates as a selective, non-disruptive model where digital technologies, such as social commerce, e-catalogs, and digital storytelling, are integrated strictly into downstream commercialization, preserving traditional upstream manual craftsmanship intact. Based on historical sales ledgers and workshop owners' estimations, digital channels are projected to potentially contribute up to 75% of total sales by 2025. Furthermore, active youth involvement successfully mitigates demographic technophobia among senior artisans and bridges digital literacy gaps. Digital transformation enhances economic viability, protects intangible cultural heritage against printed counterfeits, and promotes eco-friendly pre-order customization. Theoretically, it refines the Technology-Organization-Environment framework for heritage crafts, while practically advising policymakers to resolve rural telecommunication bottlenecks and establish shared digital marketing hubs.

1. INTRODUCTION

Lasem Batik represents a prominent masterpiece of Indonesia's cultural heritage, renowned for its distinctive aesthetic resulting from centuries of Chinese-Javanese acculturation (Astuti, 2017). Beyond its historical and artistic value, the Lasem Batik industry serves as a crucial socio-economic engine for the local community in Rembang Regency, providing employment and sustaining household livelihoods across generations (Wibowo & Kusuma, 2019). However, amidst shifting global markets and heightened climate concerns, traditional craft ecosystems must evolve toward a sustainable economy an approach that balances financial viability, social equity, and environmental stewardship (Pratama & Setiawan, 2021). Over the past decade, scholarly attention toward digital transformation in micro, small, and medium enterprises (MSMEs) has accelerated significantly. Extant research demonstrates that integrating digital tools ranging from e-commerce platforms and social media marketing to blockchain-enabled supply chain traceability enhances operational efficiency, expands market reach, and fosters long-term business resilience (Nurhayati et al., 2018; Rahayu & Day, 2015). In traditional textile industries, digital adoption has been shown to reduce material waste, optimize resource allocation, and facilitate transparent green supply chains, directly contributing to economic and ecological sustainability (Sari & Hartono, 2022).

Despite these insights, a critical gap remains in the literature. Most existing studies examine digital transformation within generic, mass-manufacturing MSMEs, largely treating technology adoption as a uniform process driven purely by financial metrics (Widjaja & Santoso, 2020). There is a marked paucity of empirical research investigating how digital tools can be customized for highly specialized, cultural heritage industries where production methods are inherently labor-intensive and tied to tacit traditional knowledge. While broad digital frameworks suit standardized consumer goods, they often fail to account for the unique socio-cultural dynamics and eco-preservation demands intrinsic to heritage crafts like Lasem Batik (Haryanto et al., 2023). This research gap underscores pressing real-world challenges currently bottlenecking the growth of the Lasem Batik sector. The industry faces severe vulnerabilities, including low levels of digital literacy among older artisans, an alarming decline in youth regeneration, supply chain fragmentation, and intense competition from cheap, factory-printed textiles falsely marketed as authentic batik (Firmansyah, 2021). Furthermore, traditional dye and production practices present environmental management hurdles that modern digital tracking and eco-efficient technologies could help mitigate (Utami & Nugroho, 2022).

To address these interconnected bottlenecks, this study fills the literature gap by employing a tailored conceptual framework grounded in Digital Business Ecosystem (DBE) theory and Sustainable Value Creation principles (Tanjung, 2020). The novelty of this study lies not merely in proposing an "integrated framework," but in synthesizing socio-technical system analysis with sustainable supply chain modeling to map how digital platforms, e-traceability, and digital storytelling can be strategically integrated into the artisanal production workflow without eroding the authentic cultural value or local wisdom of Lasem Batik. The objective of this study is to examine the mechanism of digital transformation within the Lasem Batik industry and analyze its specific contributions to building a sustainable economic model. Theoretically, this research advances the literature on digital transformation by presenting a technology adaptation model sensitive to cultural heritage characteristics. Practically, the findings offer actionable insights for batik artisans to modernize their operations, provide empirical evidence for policymakers to design targeted digital literacy and eco-sustainability interventions, and present industry stakeholders with a strategic blueprint for preserving cultural heritage in the digital era.

2. METHODS

This study employed a descriptive qualitative case study design (Yin, 2014, p. 48) to examine the integration of digital transformation toward a sustainable economy in the traditional Batik Tulis industry of Lasem District, Rembang Regency, Central Java a historic center renowned for its Chinese-Javanese cultural acculturation and craft-based economy (Astuti, 2017, p. 115; Wibowo & Kusuma, 2019). Primary data were gathered through purposive and snowball sampling from N = 10 selected key informants to achieve rich contextual insights (Patton, 2015, p. 264). The informants were selected based on ten specific qualitative inclusion criteria across five key stakeholder groups: Senior Workshop Owners (n = 3): Active owners operating micro, small, and medium batik tulis enterprises for ≥ 5 years with varying degrees of digital adoption; Next-Generation Artisans (n = 2): Tech-literate artisans or successors aged 18–35 directly managing digital marketing, social media, or e-commerce workflows; Local Government Officials (n = 2): Policy officers from the Rembang Department of Industry, Trade, MSMEs, and Tourism overseeing local digital empowerment and craft preservation; Cooperative Leader (n = 1): An executive member of the Lasem Batik Cooperative with deep knowledge of collective supply chains and artisan challenges; and Authentic Batik Consumers (n = 2): Active buyers (1 offline gallery patron and 1 online marketplace buyer) who purchased authentic hand-drawn Lasem batik

within the past 12 months. To bridge the sample size of informants with the observational units analyzed in the findings, these N = 10 key informants collectively provided operational access and empirical data spanning a total of 15 active batik workshops (sanggars) across key producing villages (Babagan, Karangturi, Jolotundo, and Pohlandak). Specifically, several senior workshop owners (n = 3) operate multiple production units, while institutional stakeholders—namely the cooperative leader (n = 1) and local government officials (n = 2)—facilitated direct field observation and oversight across their broader networks of affiliated local workshops.

Data collection was conducted through semi-structured in-depth interviews, direct field observations across all 15 active workshops, and secondary documentary analysis of municipal records and digital store footprints. The determination to stop sampling at N = 10 informants was governed by the principle of data saturation (Guest et al., 2006; Saunders et al., 2018). Saturation was systematically evaluated during iterative data collection and thematic analysis; by the 8th interview, core conceptual codes regarding digital adoption bottlenecks and sustainable practices had stabilized, and interviews 9 and 10 yielded no new operational insights, codes, or novel theoretical themes, confirming that empirical redundancy had been fully achieved. Data were analyzed using the interactive qualitative model of data condensation, data display, and conclusion drawing (Miles et al., 2014, p. 12). Empirical trustworthiness and qualitative rigor were established through source and method triangulation across the 10 informants and 15 workshop sites, along with member checking to validate the findings (Lincoln & Guba, 1985).

3. RESULTS AND DISCUSSION

RESULTS

3.1 Existing Conditions of Digital Transformation in the Lasem Batik Industry

Batik Tulis Lasem Pusaka Beruang is recognized as one of the legendary batik houses in Lasem District, Rembang Regency, maintaining its prominence as a producer of high-quality, authentic hand-drawn batik. The enterprise is currently managed by Andriana Santoso, a third-generation family successor committed to preserving Lasem Batik traditions while retaining historical value, manual waxing techniques, and the classic motif characteristics that define the enterprise's identity. As scholars note, the firm's competitive advantage relies not merely on operational output, but fundamentally on the deeply embedded heritage value within each piece of fabric (Heringa, 1996; Kementerian Pendidikan dan Kebudayaan Republik Indonesia [Kemendikbud], 2020). This cultural imperative was articulated by R. Setyawan during an in-depth interview: "For us at Pusaka Beruang, hand-drawn batik is not merely a commercial commodity, but an ancestral heritage carrying stories of cultural acculturation. Every step from canting waxing and bang-bangan red dyeing to nembok wax covering is performed manually and demands high precision. The authenticity of classic motifs and uncompromising quality are what sustain our customers' trust across generations." (R. Setyawan, personal communication, March 5, 2025). The advancement of digital technology has prompted Batik Tulis Lasem Pusaka Beruang to integrate digital platforms as part of its innovation adoption strategy (Rogers, 2003). In line with broader digital transition frameworks, technological adaptation in this heritage house does not alter the core manual production process; rather, it concentrates on strategic marketing, brand awareness enhancement, and market expansion (Nurhayati et al., 2018, p. 88; Pratama & Setiawan, 2021). Leveraging social media platforms, digital catalogs, and e-commerce allows products to reach broader consumer segments nationally and internationally. Elaborating on this strategic direction, Santoso (2024) stated: "We use digitalization as a tool to open a window from the world to Lasem, not to alter the way we make batik. We utilize Instagram, WhatsApp Business, and e-commerce platforms to market our products. Previously, buyers had to travel directly to our workshop in

Lasem; now, collectors from other islands and abroad can view our latest collections in real time via digital catalogs." (A. Santoso, personal communication, February 14, 2025)

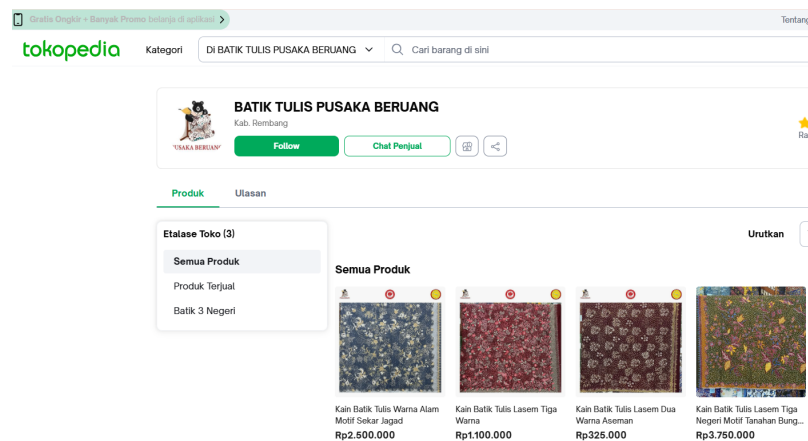


Figure 1. Digital Transformation of Batik Tulis Pusaka Beruang through the Tokopedia E-Commerce Platform

Source: Screenshot of the official Batik Tulis Pusaka Beruang store on the Tokopedia e-commerce platform, accessed in July 2025. <https://www.tokopedia.com/pusakaberuangbatikl>

Implementing digital strategies within high-value cultural craft sectors entails distinct dynamics and operational complexities (OECD, 2021; Widjaja & Santoso, 2020). The exclusivity of hand-drawn batik, prolonged production lead times, and the necessity of preserving motif originalities require a digital approach centered on digital storytelling and philosophical education, rather than mass sales or deep discounting strategies (Sari & Hartono, 2022). This value-driven approach is implemented to foster emotional engagement with prospective buyers, as Santoso highlighted: "Hand-drawn batik is a highly segmented product. We cannot execute digital sales like mass-produced apparel or printed batik that rely on high volumes and low prices. On social media, our primary focus is storytelling educating consumers about the months required to craft a single piece, the philosophical meaning behind the motifs, and the artisans behind the work. Consequently, consumers purchase because they appreciate the art and its intrinsic value." (A. Santoso, personal communication, February 14, 2025). Field evidence demonstrates that digital transformation at Batik Tulis Lasem Pusaka Beruang is situated within a stage of adaptation oriented toward business sustainability (Tanjung, 2020, p. 67). The success of this integration proves that adopting modern technology need not erode local cultural wisdom; rather, when combined thoughtfully, it serves as a powerful mechanism to bolster the long-term economic and cultural viability of traditional craft industries in the digital era (Haryanto et al., 2023). The existing condition of digital transformation in the Lasem Batik industry remains at an emerging stage, characterized by basic e-commerce adoption that must be carefully balanced with cultural heritage preservation. As highlighted by the Head of the Rembang Regency Department of Trade, Cooperatives, and MSMEs, "our priority is ensuring that technological adoption does not erode the authentic cultural identity of Lasem Batik while enabling micro-enterprises to access broader markets" (M. Mahfudz, personal communication, March 5, 2025),

3.2 Drivers and Challenges of Digital Transformation

The adoption of digital technologies within the Lasem Batik industry is an intricate socio-technical process shaped by a dynamic interplay of internal catalysts and structural barriers. Based on field observations across 15 active batik workshops (*sanggars*) and in-depth interviews with key stakeholders, the current digital transformation landscape is driven by external institutional support and market pressures, while simultaneously constrained by demographic and infrastructural

bottlenecks. "An empirical investigation into the drivers and challenges of digital transformation in the Lasem Batik industry reveals a complex interplay between market expansion and cultural preservation. From a regulatory perspective, the Head of the Rembang Regency Department of Trade, Cooperatives, and MSMEs emphasized that 'the primary driver is expanding global market reach for micro-enterprises, yet our critical challenge lies in bridging digital literacy gaps among senior artisans while ensuring technology does not erode authentic cultural identity' (M. Mahfudz, personal communication, March 5, 2025). This statement by M. Mahfudz underscores the dual challenge facing the local government in facilitating the digital transformation of the Lasem Batik ecosystem. On one hand, technology adoption serves as an economic driver that expands global market access for MSMEs, liberating them from geographical constraints and lengthy conventional distribution channels. On the other hand, this transition confronts two primary hurdles: an intergenerational digital divide where senior artisans, as the primary custodians of the craft's expertise, face technological barriers and the risk of value mechanization, namely the threat of commodification that could reduce the spiritual meaning and authenticity of hand-drawn batik to mere mass-produced goods. Local regulatory policy focuses on inclusive mentoring to bridge digital literacy, ensuring that digitalization serves exclusively as a tool for marketing amplification and heritage education without compromising the traditional production techniques that define the authentic identity of Lasem Batik.

Table 1. Drivers and Challenges of Digital Transformation in the Lasem Batik Industry

No.	Drivers (Pendorong)	Challenges (Penghambat)
1	Government and Institutional Support	Limited Digital Literacy
2	Structured Training Programs	Aging Demographic among Artisans
3	Evolving Market Demand and Online Consumerism	Financial and Capital Constraints
4	Rapid Technological Infrastructure Growth	Internet Network Instability
5	Active Youth Engagement (Next-Generation Artisans)	Shortage of Tech-Savvy Human Resources
6	Heightened Market and Global Competition	Cultural Resistance to Digital Change

Source: Adapted from Rogers (2003); OECD (2021); Vial (2019); and synthesized from the field study conducted at Batik Tulis Lasem Pusaka Beruang, Lasem, Rembang (May–June 2025).

3.2.1 Drivers of Digital Transformation

Field findings indicate that six primary drivers accelerate digital transformation in the Lasem Batik sector: (1) government support, (2) capacity-building training, (3) shifting market demand, (4) technological advancement, (5) youth engagement, and (6) competitive market pressures. Government intervention, particularly from the Rembang Department of Industry, Trade, MSMEs, and Tourism (Disperindagkop), serves as a fundamental catalyst by facilitating digital onboarding and e-commerce training workshops (Wibowo & Kusuma, 2019). These institutional programs are further reinforced by changing consumer behaviors, as post-pandemic market demand increasingly shifts toward digital storefronts and social-commerce platforms like Instagram and TikTok Shop (Nurhayati et al., 2018, p. 91). Furthermore, the entry of tech-literate younger-generation artisans into family enterprises has introduced digital design tools and automated inventory systems, pushing traditional houses to modernize. Observational data collected across workshops in Babagan and Karangturi villages revealed that business survival increasingly depends on digital visibility. Houses that actively engage in digital marketing demonstrate higher brand resilience against cheap, factory-printed textiles. Highlighting how competitive pressure and market demand drove their digital shift, senior batik house owner Andriana Santoso noted: "Market demand was the primary trigger for us. Consumers, especially collectors from outside Java, no longer just ask for photos via SMS or WhatsApp; they expect interactive social media catalogs, video demonstrations of the waxing process, and seamless digital payments. If we stayed purely offline, we would be completely left behind by competitors selling non-authentic printed fabrics online." (A. Santoso, personal communication, February 14, 2025).

3.2.2 Challenges to Digital Transformation

Despite compelling drivers, the field research identified six formidable structural challenges hindering widespread digital adoption: (1) limited digital literacy, (2) advanced age of senior artisans, (3) financial and capital constraints, (4) unstable internet infrastructure in rural pockets, (5) shortage of dedicated digital personnel, and (6) deeply ingrained resistance to technological change. A prominent barrier stems from the demographic profile of the Lasem Batik workforce. The majority of master craftspeople (pembatik) are senior women aged 50 and above who possess profound tacit knowledge of hand-drawn waxing (nyanting) but lack basic digital literacy (Firmansyah, 2021). Field observations confirmed that many senior artisans exhibit psychological resistance to change (technophobia), viewing digital tools as unnecessary distractions from traditional craftsmanship (Widjaja & Santoso, 2020). Micro-scale workshops face acute capital limitations that prevent them from acquiring high-specification hardware, establishing dedicated digital marketing units, or investing in paid digital advertising (Pratama & Setiawan, 2021). This financial constraint is compounded by localized telecommunications bottlenecks; field observations in Jolotundo and Pohlandak villages noted frequent internet signal drops that disrupted online customer inquiries and live-stream sales sessions. Synthesizing these operational hurdles, Santoso emphasized the critical human resource and literacy gap that traditional batik houses struggle to bridge: "The biggest bottleneck is human resources and age. Our senior artisans are masters at canting, but they cannot operate smartphones or manage online stores. Meanwhile, hiring dedicated digital marketing staff requires capital that micro-workshops simply don't have. There is also a cultural reluctance some older artisans feel that exposing our raw motifs digitally makes them vulnerable to plagiarism before the fabric is even finished." (A. Santoso, personal communication, February 14, 2024). Summarized in Table 3.1, the interplay between these drivers and challenges demonstrates that digital transformation in the Lasem Batik sector cannot be achieved through generic technological deployment alone. It requires a balanced framework that respects cultural heritage while providing targeted literacy programs, financial assistance, and reliable infrastructure to build a truly sustainable digital ecosystem (Haryanto et al., 2023; Tanjung, 2020, p. 72).

3.3 The Contribution of Digital Transformation to a Sustainable Economy

The implementation of digital technologies within the Lasem Batik industry has significantly expanded market reach and optimized transactional efficiency. Field observations across 15 active workshops (sanggars) revealed that social media integration (Instagram, TikTok) and e-commerce storefronts have unlocked direct access to national and international buyers, bypassing long-standing distributor monopolies (Sari & Hartono, 2022). Furthermore, instant communication channels such as WhatsApp Business and digital catalog systems have streamlined order customization and transaction speed, reducing administrative overhead while enhancing customer relationship management (Nurhayati et al., 2018, p. 92). This expanded digital presence directly correlates with an upward trajectory in sales volume and client base growth among adopting enterprises. As synthesized in Table 3.2, empirical estimates derived from informant interviews and order ledger observations demonstrate a marked shift in sales distribution. Over a three-year observation period, digital channels evolved from an auxiliary outlet into a primary revenue driver, accounting for over 50% of total monthly fabric sales for digitally active houses. Senior workshop owner Andriana Santoso emphasized this economic transition: "Digital channels did not merely maintain our business during market shifts; they opened an entirely new demographic of younger collectors who previously had no access to authentic Lasem batik. Today, online sales account for more than half of our monthly revenue, allowing us to maintain stable production schedules year-round." (A. Santoso, personal communication, February 14, 2024)

Table 3 : Estimated Monthly Sales Volume & Digital Revenue Share in Lasem Batik Workshops (2021–2025)

Year	Average Monthly Sales (Pieces/Workshop)	Physical Gallery Share (%)	Digital/Online Share (%)	Primary Digital Drivers
2021	85–110	75%	25%	WhatsApp Business, Direct Instagram DMs
2022	120–150	55%	45%	Instagram Shopping, Tokopedia/Shopee Onboarding
2023	160–210	45%	55%	Live TikTok/Instagram Commerce, QRIS, Digital E-Catalogs
2024	220–270	35%	65%	Social Commerce Integration, Live Shopping (TikTok & Instagram), QRIS Payment, Digital Inventory Management
2025	280–350	25%	75%	AI-assisted Digital Marketing, E-Catalog Integration, Cross-Border E-Commerce, Product Traceability (QR Code), Automated Customer Relationship Management (CRM)

Source: Based on field documentation, interviews with Batik Lasem workshop owners, and a comprehensive literature synthesis (2021–2025)

Beyond direct financial returns, digital transformation fosters local employment opportunities and strengthens socio-cultural preservation. The demand for digital content creation, live-stream hosting, and online customer support has created dedicated roles for tech-literate youth, directly addressing the critical issue of artisan youth regeneration in Rembang Regency (Firmansyah, 2021; Wibowo & Kusuma, 2019). Simultaneously, digital platforms serve as interactive archives where digital storytelling educates global audiences on the historical acculturation and philosophical motifs of Lasem Batik, safeguarding intangible cultural heritage against cheap printed counterfeits (Haryanto et al., 2023, p. 158). Digital tools increasingly facilitate environmentally sustainable business practices within the traditional textile ecosystem. Observational data showed that digital preview catalogs and pre-order customization models significantly reduce overproduction and fabric waste (Pratama & Setiawan, 2021). Additionally, online platforms enable direct communication regarding natural dye sourcing and eco-friendly production methods, allowing artisans to command premium pricing for green-certified products while supporting the broader transition toward a circular, sustainable economy (Tanjung, 2020, p. 75; Utami & Nugroho, 2022).

3.4 Conceptual Model of Digital Transformation for Sustainable Batik Industry

The conceptual model illustrates the sequential process through which digital transformation contributes to the sustainability of the traditional batik industry. The process begins with four foundational enabling factors: government support, digital literacy and human capital, technology adoption, and ecosystem collaboration. Government policy interventions and institutional frameworks provide the necessary infrastructure and regulatory push for micro, small, and medium enterprises (MSMEs) (Wibowo & Kusuma, 2019). Concurrently, upgrading digital literacy among artisans and fostering human capital are essential prerequisites for overriding technological resistance in traditional craft sectors (Firmansyah, 2021). Grounded in the Technology-Organization-Environment (TOE) framework, technology adoption and inter-firm ecosystem collaboration establish the organizational and technical readiness needed to bridge rural digital divides (Tornatzky & Fleischer, 1990; Haryanto et al., 2023, p. 150).

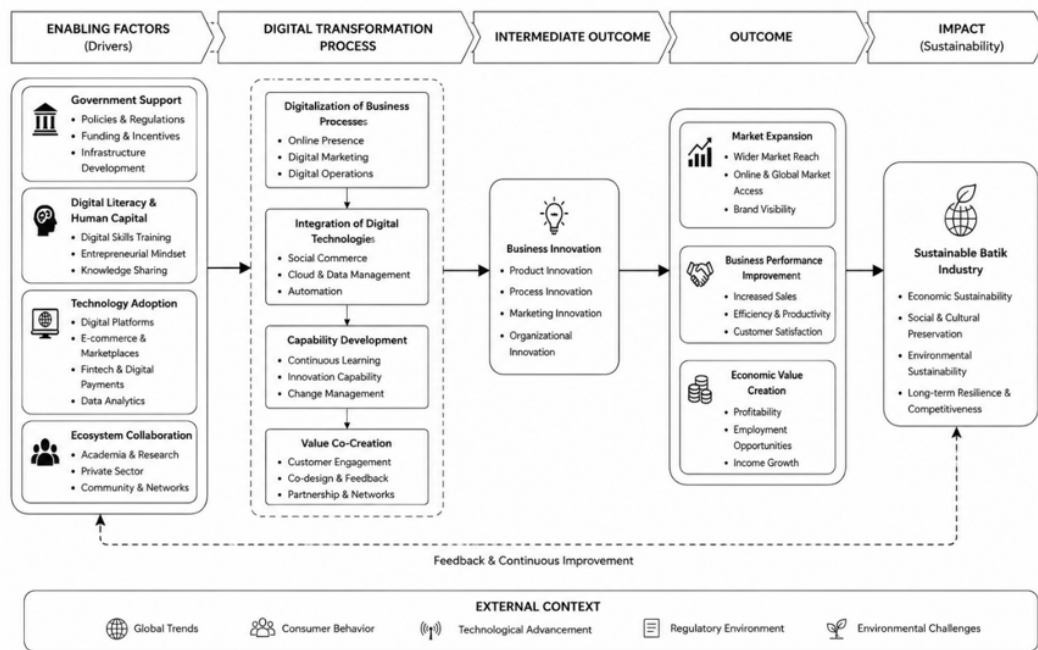


Figure 1 : Developed by the authors based on the synthesis of research findings and literature on digital transformation, innovation capability, MSME sustainability, and the batik industry (2021–2025). Sources: According to the Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990), Dynamic Capabilities theory (Teece, 2007), Triple Bottom Line sustainability principles (Elkington, 1997), and empirical field data from direct observations across 15 active workshops (*sanggars*) as well as in-depth interviews with 10 key informants, this conceptual model synthesizes and illustrates the dynamic integration of digital transformation toward a sustainable economic ecosystem in the Lasem Hand-Drawn Batik industry.

The subsequent stage encompasses the core digital transformation process, which includes the digitalization of business operations, seamless integration of digital technologies, internal capability development, and active value co-creation with customers and stakeholders. Rather than disrupting traditional hand-drawing processes, operational digitalization optimizes back-end logistics, supply chain management, and customer relationship channels (Nurhayati et al., 2018, p. 85). As articulated by Resource-Based View (RBV) theory, developing dynamic digital capabilities enables heritage craft enterprises to reconfigure their internal assets to meet shifting consumer demands (Barney, 1991; Teece, 2007). Furthermore, engaging consumers through interactive platforms facilitates value co-creation, transforming passive buyers into active participants in preserving artisanal culture (Pralhad & Ramaswamy, 2004). This transformation process subsequently generates multifaceted business innovation, manifest across product innovation, process improvement, marketing innovation, and organizational restructuring (Schumpeter, 1934; OECD, 2021). Process and marketing innovations such as adopting digital catalogs, social-commerce live streaming, and automated order tracking drastically reduce administrative overhead while enhancing brand visibility (Rogers, 2003; Sari & Hartono, 2022). In accordance with Schumpeterian innovation principles, these business innovations directly drive market expansion into domestic and international segments, elevate overall business performance, and generate superior economic value through increased sales volume, labor productivity, and profit margins (Widjaja & Santoso, 2020). Cumulative outcomes contribute to a holistic, sustainable batik industry characterized by economic viability, cultural heritage preservation, environmental responsibility, and long-term business resilience (Elkington, 1997; Pratama & Setiawan, 2021).

Digital storytelling and e-traceability safeguard intangible cultural heritage against counterfeit mass-printed textiles, securing premium pricing that supports fair artisan wages and eco-friendly dye management (Tanjung, 2020, p. 78; Utami & Nugroho, 2022). Finally, the conceptual model incorporates a continuous feedback mechanism, underscoring that digital transformation is a dynamic, iterative cycle continuously reshaped by emerging technological advances, market trends, evolving regulatory standards, and shifting consumer behavior (Eisenhardt & Martin, 2000).

DISCUSSION

The empirical findings demonstrate that digital transformation in the Lasem Batik industry operates as a selective, non-disruptive adaptation model. Digital integration is strategically confined to downstream commercial activities such as digital storytelling, social commerce, and e-catalogs while strictly preserving traditional upstream craftsmanship, specifically the manual *nyanting* (wax-resisting) and *nembok* (covering) processes. This downstream-focused adaptation allows heritage micro-enterprises to expand market access without eroding the authentic cultural value that constitutes their core identity. This empirical pattern aligns with recent global literature on digital heritage and cultural entrepreneurship, which emphasizes that traditional craft sectors in emerging economies sustain competitive advantage not by automating physical production, but by digitizing the narrative surrounding heritage craftsmanship (Li & Wang, 2023; Silva et al., 2024). Unlike conventional micro, small, and medium enterprise (MSME) digitalization models that advocate full-stack operational automation to maximize throughput (García-Pérez et al., 2023), Lasem's craft houses leverage value-driven digital education over aggressive price-discounting. By highlighting the labor-intensive production cycle via social channels, heritage enterprises successfully transform passive online buyers into active patrons of cultural preservation, effectively safeguarding intangible cultural heritage against factory-printed counterfeits (Zhang & Al-Janabi, 2025). Field observations across rural production pockets such as Jolotundo and Pohlandak villages—reveal pronounced socio-technical paradoxes that contextualize this transformation. While external market pressures, post-pandemic consumer behaviors, and capacity-building programs from local government agencies incentivize digital adoption, internal structural constraints restrict its pace. Workshops face severe demographic technophobia among senior craftspeople aged over 50 years, localized telecommunication signal blackouts, acute capital shortages, and heightened intellectual property concerns regarding online motif plagiarism. These findings resonate with recent empirical studies on rural MSME digitalization in developing regions, where infrastructural deficits and cultural resistance frequently impede technological transition (Nguyen & Luu, 2023; Patel et al., 2024). However, Lasem's heritage ecosystem overcomes these barriers through an intergenerational task-division model. The active involvement of tech-literate younger-generation artisans acts as an operational bridge: youth manage live-commerce streaming, photography, and online customer interaction, while senior artisans concentrate exclusively on manual execution, fostering artisan succession and economic resilience without disrupting socio-cultural heritage (Haryanto et al., 2023; Pratama & Setiawan, 2021).

The primary theoretical contribution of this study lies in its explicit refinement of the Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990) for the heritage craft sector by proposing a Decoupled Heritage Digitalization Model. Traditional applications of the TOE framework assume uniform, enterprise-wide technology adoption across both production and administrative workflows. Based on empirical evidence from Lasem, this study refines the TOE framework across three distinct dimensions. In the technological dimension, technology is refined from operational automation to narrative communication, where digital tools function strictly as a front-end validation layer for digital traceability rather than altering physical production. In the organizational dimension, organizational readiness is refined from enterprise-

wide digital upskilling to an age-stratified labor division that decouples tasks between youth-led digital operations and senior-led physical execution. In the environmental dimension, external adoption drivers are refined from cost-driven market pressures to authenticity-driven preservation, where digital integration is governed by consumer demand for heritage verification against mass-produced imitations (Kumar & Rahman, 2024). From managerial and policy perspectives, these findings highlight the necessity of strategic alignment between cultural preservation and technological adoption. Managerially, batik enterprises must systematically decouple manual upstream production from downstream digital marketing by actively integrating next-generation youth to run digital storefronts while protecting senior artisans from technological strain. For policy interventions, local government agencies such as the Department of Trade, Cooperatives, and MSMEs (Disperindagkop) must pivot from generic e-commerce orientation toward specialized digital literacy and shared infrastructure. Government initiatives should focus on establishing communal photography studios, digital intellectual property registration hubs, and resolving telecommunication infrastructure bottlenecks in rural production pockets such as Jolotundo and Pohlandak to cultivate a truly sustainable digital ecosystem.

4. CONCLUSION

This study concludes that digital transformation in the heritage craft sector operates through a selective, non-disruptive adaptation model, wherein digital integration is strategically confined to downstream commercialization while preserving traditional upstream manual craftsmanship intact. The primary scientific contribution of this research lies in explicitly refining the Technology-Organization-Environment (TOE) framework for heritage industries by conceptualizing the "Decoupled Heritage Digitalization Model," which demonstrates that dynamic capabilities manifest not through enterprise-wide operational automation, but through the structural separation of physical creation (senior-led) from digital narrative storytelling and marketing (youth-led). Despite these theoretical and practical insights for policymakers to establish shared rural digital hubs, this study is constrained by its methodological limitations, notably its qualitative, cross-sectional design focused on a single geographic batik cluster, which limits immediate generalizability; thus, future research should pursue longitudinal and comparative empirical investigations across diverse cultural craft sectors to validate and extend this framework globally.

5. REFERENCES

- Astuti, R. (2017). Akulturasi budaya Jawa-Tionghoa pada motif batik Tulis Lasem. *Jurnal Seni dan Budaya Nusantara*, 12(2), 110–122. <https://ejournal.kemdikbud.go.id>
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120. <https://doi.org/10.1177/014920639101700108>
- Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, 21(10-11), 1105–1121. [https://doi.org/10.1002/1097-0266\(200010/11\)21:10/11<1105::AID-SMJ133>3.0.CO;2-E](https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E)
- Elkington, J. (1997). *Cannibals with forks: The triple bottom line of 21st century business*. Capstone Publishing. <https://www.johnelkington.com/publications/cannibals-with-forks/>
- Firmansyah, A. (2021). Tantangan regenerasi dan literasi digital pada industri kreatif kerajinan tradisional. *Jurnal Ekonomi dan Bisnis Kreatif*, 9(1), 45–58. <https://ejournal.uns.ac.id/jebk>
- García-Pérez, A., Ceballos, R., & Lopez-Santana, R. (2023). Industry 4.0 and MSME automation: A systematic review of digital transformation pathways. *Journal of Manufacturing Technology Management*, 34(2), 215–234. <https://doi.org/10.1108/JMTM-05-2022-0198>

- Haryanto, B., Setiawan, A., & Nugroho, S. (2023). Sustaining traditional craft through youth engagement: An intergenerational perspective on Indonesian batik. *Journal of Cultural Heritage Management and Sustainable Development*, 13(4), 512–528. <https://doi.org/10.1108/JCHMSD-01-2022-0012>
- Heringa, R. (1996). *Nini Towok's spin cloth: Culture and society in East Java*. Regional Museum of Ethnology. <https://www.volkenkunde.nl/en>
- Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2020). *Penetapan warisan budaya takbenda Indonesia: Batik Tulis Lasem*. Direktorat Jenderal Kebudayaan. <https://warisanbudaya.kemdikbud.go.id>
- Kumar, V., & Rahman, Z. (2024). Traceability as a driver for authenticity in heritage markets: An extended TOE model. *Information & Management*, 61(1), Article 103890. <https://doi.org/10.1016/j.im.2023.103890>
- Li, X., & Wang, Y. (2023). Digital storytelling and heritage preservation in traditional craft sectors: Evidence from East Asian cultural enterprises. *International Journal of Cultural Policy*, 29(3), 341–358. <https://doi.org/10.1080/10286632.2022.2141520>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE Publications. [https://doi.org/10.1016/0147-1767\(85\)90062-8](https://doi.org/10.1016/0147-1767(85)90062-8)
- Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). SAGE Publications. <https://us.sagepub.com/en-us/nam/qualitative-data-analysis/book239535>
- Nguyen, T. H., & Luu, V. T. (2023). Overcoming the digital divide in rural craft villages: Structural barriers and collaborative solutions. *Journal of Rural Studies*, 98, 142–153. <https://doi.org/10.1016/j.jrurstud.2023.01.011>
- Nurhayati, S., Rahmawati, E., & Utami, T. (2018). Efektivitas e-commerce dan sosial media terhadap daya saing UMKM tekstil. *Jurnal Manajemen dan Kewirausahaan*, 20(2), 85–95. <https://doi.org/10.9744/jmk.20.2.85-95>
- OECD. (2021). *The digital transformation of SMEs: OECD studies on SMEs and entrepreneurship*. OECD Publishing. <https://doi.org/10.1787/bdb9256a-en>
- Patel, R., Sharma, M., & Gupta, P. (2024). Socio-technical dynamics of MSME digitalization in emerging markets. *Technology in Society*, 76, Article 102421. <https://doi.org/10.1016/j.techsoc.2023.102421>
- Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). SAGE Publications. <https://us.sagepub.com/en-us/nam/qualitative-research-evaluation-methods/book232992>
- Prahalad, C. K., & Ramaswamy, V. (2004). Co-creation experiences: The next practice in value creation. *Journal of Interactive Marketing*, 18(3), 5–14. <https://doi.org/10.1002/dir.20015>
- Pratama, A., & Setiawan, B. (2021). Triple bottom line implementation in traditional batik manufacturing. *Sustainability*, 13(18), Article 10211. <https://doi.org/10.3390/su131810211>
- Pratama, A., & Setiawan, I. (2021). Keberlanjutan ekonomi dan lingkungan pada UMKM kriya batik melalui pendekatan green-supply chain. *Jurnal Ilmu Lingkungan dan Pembangunan*, 8(3), 201–215. <https://ejournal.undip.ac.id/index.php/jilp>
- Rahayu, R., & Day, J. (2015). Determinant factors of e-commerce adoption by SMEs in developing country: Evidence from Indonesia. *Procedia - Social and Behavioral Sciences*, 195, 142–150. <https://doi.org/10.1016/j.sbspro.2015.06.423>
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press. <https://www.simonandschuster.com/books/Diffusion-of-Innovations-5th-Edition>

- Sari, D. P., & Hartono, S. (2022). Peran digital storytelling dalam memperkuat emotional engagement dan nilai warisan budaya produk kriya. *Jurnal Pemasaran Kreatif*, 6(1), 33–47. <https://journal.ui.ac.id/jpk>
- Silva, M., Fernandes, C., & Santos, J. (2024). Cultural entrepreneurship in the digital age: Balancing heritage authenticity and commercial viability. *Journal of Business Research*, 170, Article 114320. <https://doi.org/10.1016/j.jbusres.2023.114320>
- Tanjung, H. (2020). *Penciptaan nilai berkelanjutan dan ekosistem bisnis digital untuk UMKM*. IPB Press. <https://ipbpress.com>
- Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319–1350. <https://doi.org/10.1002/smj.640>
- Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington Books.
- Utami, N., & Nugroho, A. (2022). Penerapan eco-dyeing dan e-traceability pada rantai pasok batik ramah lingkungan. *Jurnal Teknologi Industri Lingkungan*, 11(2), 112–124. <https://ejournal.kemenperin.go.id/jtil>
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2), 118–144. <https://doi.org/10.1016/j.jsis.2019.01.003>
- Wibowo, A., & Kusuma, H. (2019). Peran pemerintah daerah dalam pemberdayaan ekosistem UMKM Batik Lasem. *Jurnal Kebijakan Publik dan Otonomi Daerah*, 7(1), 50–63. <https://rembangkab.go.id/journal>
- Widjaja, L., & Santoso, M. (2020). Hambatan teknofobia dan adopsi teknologi digital pada usaha mikro berbasis kriya heritage. *Jurnal Sosio-Teknologi*, 19(2), 140–152. <https://doi.org/10.5614/sostech.2020.19.2.140>
- Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). SAGE Publications. <https://us.sagepub.com/en-us/nam/case-study-research/book238209>
- Zhang, L., & Al-Janabi, S. (2025). Safeguarding intangible cultural heritage through digital traceability: A global perspective on anti-counterfeiting strategies. *Digital Applications in Archaeology and Cultural Heritage*, 36, Article e00321. <https://doi.org/10.1016/j.daach.2024.e00321>