

AI Investment and Cultural Design Innovation: A Conceptual Framework for the Future of Batik in the Digital Economy

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ABSTRACT

The rapid advancement of artificial intelligence (AI) is transforming creative industries worldwide, yet limited attention has been given to how AI investment can support cultural design innovation in heritage-based industries such as batik. This gap highlights the need for a comprehensive framework that explains the role of AI in enhancing both cultural and economic value within the digital economy. Therefore, this study aims to develop a conceptual framework that examines the relationships between AI investment, AI design capability, human–AI co-creation, and cultural design innovation in the batik industry. Employing a conceptual research design, the study synthesises contemporary literature on AI, innovation management, cultural heritage, and creative industries through a structured literature review and theory integration approach. The findings propose that AI investment strengthens design capabilities and collaborative innovation processes, leading to cultural and economic value creation. The study contributes theoretically by integrating Resource-Based View, Dynamic Capabilities, and Cultural Capital Theory, while offering practical insights for policymakers and industry practitioners seeking to sustain batik innovation in the digital economy.

Keywords: Artificial intelligence investment, cultural design innovation, batik, digital economy, human–AI co-creation

INTRODUCTION

The rapid advancement of artificial intelligence (AI) has emerged as one of the most transformative global developments of the digital economy, fundamentally reshaping how creativity, innovation, and cultural production are generated across industries. In recent years, generative AI technologies have expanded beyond technical applications to influence architecture, fashion, visual arts, media, publishing, cultural heritage, and design sectors. While AI offers unprecedented opportunities to enhance creative productivity, accelerate design processes, and create new forms of cultural expression, it simultaneously raises concerns regarding cultural authenticity, intellectual property rights, creative labor displacement, and the preservation of intangible cultural heritage. International organizations and policymakers increasingly recognize that AI is transforming cultural and creative industries worldwide, creating both opportunities for innovation and challenges related to cultural diversity, copyright protection, market fairness, and the long-term sustainability of creative ecosystems. Consequently, the relationship between AI, creativity, cultural heritage, and investment has become a critical global issue requiring new theoretical and policy perspectives.

In Malaysia, the convergence of artificial intelligence (AI), digital transformation, and creative industry development has become an increasingly important national agenda. The Malaysian government has intensified efforts to position the country as a regional digital and AI hub through strategic investments in digital infrastructure, cloud computing, data centres, and AI capabilities. Recent national initiatives, including the establishment of the National AI Office (NAIO) and partnerships with global technology companies, reflect Malaysia's commitment to accelerating AI adoption across economic sectors. In 2025, the Malaysia Digital Economy Corporation (MDEC) reported RM87.4 billion in approved digital investments, largely driven by AI,

cloud services, big data, and digital infrastructure development. Similarly, Malaysia recorded a historic RM378.5 billion in approved investments in 2024, with a substantial share directed toward digital and technology-related sectors, highlighting the growing significance of AI-driven economic transformation. Major global technology firms, including Google, Microsoft, Oracle, Amazon, and ByteDance, have collectively committed billions of dollars to AI-related infrastructure and cloud investments in Malaysia, reinforcing the country's ambition to become a leading digital economy in Southeast Asia.

The increasing emphasis on AI investment is particularly significant for Malaysia's cultural and creative industries, which have emerged as an important contributor to national economic growth. According to the Department of Statistics Malaysia (DOSM), the cultural and creative industry contributed RM130.7 billion, equivalent to 6.8% of Malaysia's Gross Domestic Product (GDP), in 2024. Within this sector, design and creative services represented one of the fastest-growing domains, supported by advancements in advertising, media, architecture, engineering, and digital creative activities. Furthermore, Malaysia's exports of creative products rebounded strongly to RM63.0 billion in 2024, demonstrating the increasing commercial importance of creative and design-based industries within the global economy. These developments indicate that cultural creativity is no longer viewed solely as a heritage asset but increasingly as an economic resource capable of generating innovation, competitiveness, and value creation.

In spite of this progress, the application of AI within heritage-based creative sectors such as batik remains relatively underexplored. Batik occupies a unique position within Malaysia's cultural landscape as both a traditional artistic practice and a commercially valuable creative product. As consumer preferences evolve and digital marketplaces expand, batik producers face increasing pressure to innovate while preserving cultural authenticity and symbolic meaning. Emerging AI technologies offer opportunities for motif generation, pattern analysis, design customization, digital archiving, and market intelligence. However, limited scholarly attention has been given to how AI investment can support cultural design innovation in batik while simultaneously enhancing cultural value, economic competitiveness, and long-term sustainability. Consequently, there is a need for a conceptual framework that explains how AI investment may facilitate the future development of batiks design within Malaysia's rapidly evolving digital economy.

Within design and cultural product development, emerging empirical studies demonstrate that AI-assisted design systems are increasingly applied in early-stage conceptualisation, pattern generation, and digital prototyping of cultural products. For instance, AI-based design frameworks have been applied in cultural artefact development to improve efficiency and innovation outcomes, yet these applications remain largely experimental and context-specific rather than theoretically grounded in investment and value creation perspectives (International Journal of Management, Finance and Accounting, 2025). In the Malaysian context, recent studies on digital creative industries show a gradual shift toward the integration of Industry 4.0 technologies, including AI-driven tools, in design practices such as fashion, multimedia, and cultural applications; however, research on batik specifically remains limited, with most studies focusing on cultural preservation, digitalisation efforts, or application-based design without examining strategic investment mechanisms (ANDHARUPA Journal, 2024; Ideology Journal, 2025). Furthermore, existing literature on Malaysian creative industries highlights persistent challenges such as skills gaps, limited technological readiness, and fragmented digital adoption, which hinder the full realisation of AI-driven cultural innovation.

Despite the growing body of literature on artificial intelligence (AI) in creative industries and the increasing recognition of cultural and creative sectors as strategic economic drivers, several critical gaps remain. First, existing studies predominantly focus on AI applications in generic design, media, and commercial creative industries, with limited theoretical attention to heritage-based cultural systems such as batik. Second, while prior research acknowledges the role of AI in enhancing creative productivity and innovation, it largely treats AI as an operational tool rather than a strategic form of investment that contributes to long-term cultural design capability and value creation. Third, current literature remains fragmented in explaining the mechanism through which AI investment translates into cultural design innovation, particularly in contexts where cultural authenticity, symbolic meaning, and traditional knowledge systems are central to product identity. These limitations indicate the absence of an integrated conceptual framework that systematically links AI investment, cultural design innovation, and value creation within the digital economy, especially in emerging creative economies such as Malaysia.

AIMS OF STUDY

In response to these gaps, this study aims to develop a conceptual framework that explains how AI investment influences cultural design innovation and value creation in the batik industry within the digital economy context. Specifically, the objectives of this paper are threefold: (1) to conceptualise AI investment as a strategic driver of cultural design innovation; (2) to develop an integrated framework that explains the relationship between AI-enabled design processes and cultural value creation in batik; and (3) to propose theoretical propositions that guide future empirical research on AI-driven innovation in heritage-based creative industries. By achieving these objectives, this study contributes to the growing discourse on digital transformation in cultural industries and provides a structured foundation for understanding how AI can be strategically leveraged to enhance both economic and cultural value in batik design.

Finally, the structure of this paper is organised as follows. The next section reviews the relevant literature on AI investment, cultural design innovation, and value creation in creative industries. This is followed by the development of the conceptual framework and theoretical propositions that explain the relationships among key constructs. The paper then discusses the implications of the proposed framework for theory, practice, and policy development in the context of the digital economy. The final section concludes the study by summarising its main contributions and suggesting directions for future research in AI-driven cultural and design innovation.

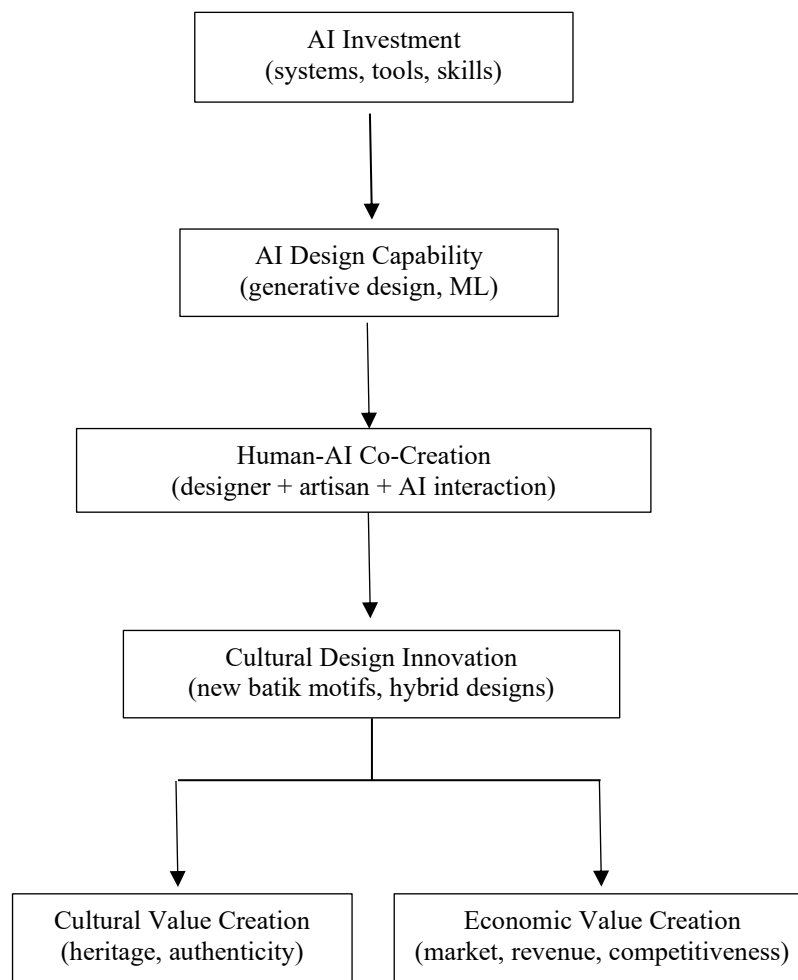


Fig. 1. Conceptual Framework Diagram

This study develops a conceptual framework that explains how artificial intelligence (AI) investment contributes to cultural design innovation and value creation within the batik industry in the digital economy. The framework is grounded in the Resource-Based View (RBV), Dynamic Capabilities Theory, and Cultural Capital Theory, which collectively provide a multi-dimensional lens for understanding how technological investment interacts with cultural knowledge systems to generate innovation and economic outcomes. In this context, AI investment is conceptualised not merely as a technological expenditure, but as a strategic organisational resource that enables

the development of design capabilities, supports human–AI collaboration, and enhances cultural and economic value creation in heritage-based creative industries.

The first construct in the framework is AI investment, which refers to the allocation of financial, technological, and human resources toward artificial intelligence systems, including generative design tools, machine learning platforms, and digital infrastructure that support creative processes. From a Resource-Based View perspective, AI investment is considered a strategic asset that enhances a firm's ability to develop unique and difficult-to-imitate capabilities. However, the impact of AI investment is not direct; rather, it operates through the development of AI design capability. AI design capability reflects the ability of organisations and designers to utilise AI technologies for ideation, pattern generation, design optimisation, and creative exploration. This capability enables firms to transform technological resources into meaningful design outputs, thereby strengthening their innovation potential.

The second key mechanism in the framework is human–AI co-creation, which represents the interactive process between designers, artisans, and AI systems in producing cultural designs. In the context of batik, this co-creation process is particularly significant as it integrates computational creativity with traditional knowledge systems. Human–AI co-creation enables the reinterpretation of cultural motifs, supports rapid prototyping of design alternatives, and facilitates hybrid creative processes that combine algorithmic suggestions with human artistic judgment. This interaction is consistent with Dynamic Capabilities Theory, which emphasises the importance of integrating and reconfiguring internal and external competencies to respond to changing environmental conditions in the digital economy.

The third construct is cultural design innovation, which refers to the development of new, improved, or hybrid batik designs that emerge from the integration of AI capabilities and human creativity. This includes innovation in motifs, patterns, colour schemes, and digital design applications that maintain cultural relevance while enhancing aesthetic and market appeal. Cultural design innovation serves as the central outcome of the co-creation process and acts as a critical driver of value creation in both cultural and economic dimensions. From the perspective of Cultural Capital Theory, such innovation must balance the preservation of cultural identity with adaptation to contemporary market demands, ensuring that batik retains its symbolic and heritage value while remaining commercially viable.

Finally, the framework distinguishes between cultural value creation and economic value creation as dual outcomes of cultural design innovation. Cultural value creation refers to the preservation, reinforcement, and reinterpretation of cultural identity, authenticity, and heritage significance embedded within batik designs. Economic value creation, on the other hand, refers to improvements in market performance, competitiveness, revenue generation, and commercial scalability of batik products in domestic and international markets. The framework proposes that AI investment contributes to these outcomes indirectly through a sequential process involving AI design capability, human–AI co-creation, and cultural design innovation.

Based on the proposed relationships, this study advances five theoretical propositions. First, AI investment is expected to positively influence AI design capability. Second, AI design capability is expected to enhance human–AI co-creation in batik design processes. Third, human–AI co-creation is expected to positively contribute to cultural design innovation. Fourth, cultural design innovation is expected to generate both cultural and economic value creation. Finally, AI design capability and human–AI co-creation are proposed to sequentially mediate the relationship between AI investment and cultural design innovation. Collectively, these propositions form an integrated conceptual model that explains how AI-driven technological investment can be leveraged to transform cultural design practices and generate sustainable value within the batik industry in the digital economy.

LITERATURE REVIEW

Artificial Intelligence in Cultural and Creative Industries

Recent literature consistently highlights that artificial intelligence (AI), particularly generative AI, is fundamentally transforming cultural and creative industries (CCIs) by reshaping creative processes, production systems, and value creation mechanisms. A growing body of research indicates that AI technologies enhance

creative productivity by accelerating ideation, enabling generative design, and supporting multimodal content creation across visual, textual, and design-based domains (Anantrasirichai et al., 2026). Systematic reviews further show that AI in CCIs is characterised by rapid expansion but also high fragmentation, particularly in relation to cultural heritage applications, where theoretical integration remains limited (Technovation, 2026). Similarly, recent studies emphasise that generative AI introduces new paradigms of “augmented creativity,” where machines and humans collaborate in producing creative outputs rather than AI merely serving as a production tool (Sharma & Singhal, 2026; Systems, 2026).

In addition, empirical studies suggest that AI-driven creative systems influence not only efficiency but also the diversity and variability of creative outputs. For example, experimental research shows that exposure to AI-generated ideas increases idea diversity and exploration in creative tasks, even if it does not always improve individual-level creativity quality (Ashkinaze et al., 2024). These findings suggest that AI plays a structural role in reshaping creative ecosystems by altering how ideas are generated, evaluated, and recombined. However, despite these advances, current literature remains heavily concentrated on digital media, fashion, advertising, and general design applications, with limited attention to heritage-based cultural design systems such as batik.

Human–AI Co-Creation and Cultural Design Innovation

Recent studies increasingly conceptualise AI not as a replacement for human creativity but as a co-creative partner in the design process. Research on human–AI co-creativity demonstrates that AI systems can act as active collaborators in creative tasks, influencing ideation, design variation, and problem-solving processes (Singh et al., 2025). In design contexts, human–AI collaboration has been shown to enhance creative exploration, particularly when systems are designed to support high user control and adaptive interaction.

In cultural and fashion-related domains, generative AI has been applied to reimagine traditional design processes, enabling hybrid forms of creativity that combine computational generation with human aesthetic judgment (Chauvin et al., 2025). Studies in fashion and textile design similarly indicate that AI can support rapid prototyping, pattern generation, and design experimentation, while also raising ethical and cultural concerns regarding authenticity and originality (Gurel, 2025). Despite these developments, there remains limited theoretical clarity on how human–AI co-creation translates specifically into cultural design innovation within heritage-based industries.

Theoretical Foundations: AI Investment and Cultural Design Innovation

The conceptualisation of AI investment and cultural design innovation in this study is grounded in three complementary theoretical perspectives: the Resource-Based View (RBV), Dynamic Capabilities Theory, and Cultural Capital Theory. Collectively, these theories provide a robust framework for explaining how technological investment can be transformed into cultural and economic value within heritage-based creative industries such as batik.

From a Resource-Based View (RBV), AI investment is understood as a strategic organisational resource that enables firms to develop unique and inimitable capabilities in design innovation and creative production. In the context of the digital economy, AI technologies—such as generative design systems, machine learning algorithms, and data-driven creative tools—constitute intangible strategic assets that enhance firms’ ability to achieve competitive advantage through improved design efficiency, differentiation, and innovation performance. However, RBV alone is insufficient to explain the dynamic processes through which AI resources are continuously reconfigured in response to changing technological and cultural environments.

To address this limitation, Dynamic Capabilities Theory is employed to explain how organisations integrate, build, and reconfigure AI-enabled competencies to adapt to rapidly evolving digital and creative ecosystems. Within this perspective, AI investment is not a static asset but a capability-building mechanism that enables human–AI co-creation, iterative design development, and continuous innovation in cultural products. This dynamic interaction is particularly relevant in batik design, where innovation must remain responsive to both technological advancement and shifting cultural and market demands.

Complementing these perspectives, Cultural Capital Theory provides a critical lens for understanding how batik design embodies symbolic meaning, heritage value, and identity expression. Unlike purely commercial design systems, batik operates within a culturally embedded framework where innovation must preserve authenticity while enabling reinterpretation. In this sense, cultural capital theory explains the dual imperative of cultural preservation and innovation, highlighting the tension and balance between tradition and modernity in AI-enabled design processes. When integrated, these three theoretical perspectives collectively conceptualise AI investment as a multidimensional construct that simultaneously generates technological capability, innovation capacity, and cultural value within the digital economy.

Research Gaps and Concluding Insights

Despite the growing body of literature on artificial intelligence in creative industries and increasing recognition of digital transformation in cultural economies, several critical gaps remain. First, existing studies largely emphasise AI applications in commercial design, media production, and general creative sectors, while limited attention is given to heritage-based cultural systems such as batik, where cultural meaning and identity are central to design innovation. Second, although AI is widely acknowledged as a driver of creativity and innovation, it is still predominantly conceptualised as a technological tool rather than a strategic investment that builds long-term cultural design capability and value creation potential. Recent studies increasingly call for a shift from tool-based perspectives to capability-based and investment-oriented frameworks in AI-driven innovation research (UNESCO, 2024; Stanford AI Index, 2024).

Third, the literature remains fragmented in explaining the mechanisms through which AI investment translates into cultural design innovation and dual value creation (cultural and economic), particularly in the context of traditional craft industries undergoing digital transformation. While emerging studies highlight the role of human–AI co-creation in enhancing design outcomes, they rarely integrate this process within a broader investment and cultural value framework. Furthermore, research on AI in cultural heritage contexts remains underdeveloped, despite growing global concern regarding the preservation of intangible cultural heritage in the era of generative technologies (UNESCO, 2024; Creative Economy Report discussions, 2025).

In summary, existing literature suggests a clear theoretical and empirical disconnect between AI investment, cultural design processes, and value creation outcomes. This gap underscores the need for an integrated conceptual framework that explains how AI investment can be strategically leveraged to enhance cultural design innovation while simultaneously preserving cultural identity and generating economic value. Addressing this gap is essential for advancing both academic understanding and practical implementation of AI-driven transformation in heritage-based creative industries within the digital economy.

Table 1: Recent Studies on AI, Batik, Cultural Design Innovation, and Value Creation (2020–2025)

Author(s)	Year	Title	Method	Key Findings
Anantrasirichai & Bull	2020	Artificial Intelligence in the Creative Industries: A Review	Systematic review	AI is mainly used as a creative assistant , not a full replacement; strongest impact is on augmenting human creativity and workflow efficiency.
Naser et al.	2021	Innovation of Batik Block Through Design Thinking Process	Qualitative case study	Design thinking improves batik sustainability and innovation; highlights importance of community-based innovation in heritage industries.

Shaharuddin et al.	2021	A Review on Malaysian and Indonesian Batik Production, Challenges, and Innovations	Literature review	Batik industries face challenges in modernization, commercialization, and innovation capacity , requiring digital adaptation.
SP-BatikGAN Study	2023	SP-BatikGAN: Efficient GAN for Symmetric Pattern Generation	Experimental AI model development	AI (GAN) can generate batik-like patterns with improved diversity; confirms feasibility of algorithmic batik design generation .
Inie et al.	2023	Designing Participatory AI: Creative Professionals' Worries and Expectations	Qualitative study	Designers prefer human–AI collaboration rather than full automation; concerns include authenticity and creative control.
Ashkinaze et al.	2024	Generative AI and Creativity: Experimental Evidence	Experimental research	AI increases idea diversity but not necessarily quality , suggesting AI supports exploration in design innovation.
Rahmat et al.	2024	Open Innovation and Circular Economy in Batik SMEs	Quantitative (SEM)	Open innovation significantly improves SME performance and competitiveness in batik sector.
Ardhianto et al.	2024	Integrating Generative AI into Bakaran Batik	Experimental study	AI improves design speed and workflow efficiency , reducing traditional production time in batik design.
Rusnalasari & Hermansyah	2024	Ethical Frameworks for Digital Batik Representation	Mixed methods	Digital batik innovation raises concerns about ethical design, cultural appropriation, and authenticity loss .
Feng et al.	2024	Particle Batik: Digitalizing Traditional Batik via Algorithmic System	Computational design	Algorithmic systems can reproduce batik patterns digitally, supporting cultural digitization and preservation .
Kusumawati et al.	2025	AI-Driven Generative Design for Batik Innovation	Experimental technopreneurship study	AI enhances market-oriented batik innovation and personalization , supporting creative industry growth.
Sharma & Singhal	2025	Human–AI Co-Creation in Design Systems	Conceptual empirical synthesis	Human–AI co-creation improves design novelty and innovation performance , but requires governance frameworks.
Technovation Review	2025	AI in Creative Industries: Systematic Review	Systematic review	AI reshapes creative industries but lacks integration with heritage-based cultural systems .
UNESCO Report	2024	AI and Digital Transformation in Cultural Industries	Policy report	AI presents both opportunities and risks for cultural preservation and creative economy sustainability .

Comprehensive Explanation (Literature Synthesis)

As shown in Table 1, the literature from 2020 to 2025 demonstrates a clear evolution in the role of artificial intelligence within creative industries, moving from early-stage computational tools to advanced generative systems capable of co-creating design outputs. Early studies, such as Anantrasirichai and Bull (2020), conceptualised AI primarily as a supportive mechanism that enhances human creativity rather than replacing it. This foundational view is consistent with later findings, which emphasise AI's role in augmenting ideation, improving workflow efficiency, and enabling design exploration in creative domains.

From 2021 onward, research increasingly shifted toward cultural and heritage-based innovation, particularly in batik production systems. Studies such as Shaharuddin et al. (2021) and Naser et al. (2021) highlight that batik industries face structural challenges related to innovation capacity, market competitiveness, and digital transformation readiness. These studies collectively suggest that while batik holds strong cultural value, its economic sustainability increasingly depends on innovation and modernization strategies.

Between 2023 and 2024, research began integrating artificial intelligence directly into batik design processes. Experimental studies such as SP-BatikGAN (2023) and generative AI applications in Bakaran Batik (2024) demonstrate that AI systems can successfully generate batik patterns, improve design efficiency, and accelerate production workflows. However, these studies also reveal limitations in cultural authenticity and design meaning, indicating that AI-generated outputs require human interpretation and cultural grounding.

More recent research (2024–2025) expands the discussion toward **human–AI co-creation, ethical design governance, and investment-based perspectives**. For example, Inie et al. (2023) and Sharma & Singhal (2025) emphasise that AI is most effective when used in collaborative systems rather than autonomous generation. Similarly, ethical studies on digital batik highlight concerns about cultural dilution, intellectual property, and symbolic misrepresentation in algorithmic design systems. At the same time, technopreneurship and SME-based studies demonstrate that AI adoption can significantly enhance market performance, innovation capacity, and commercialization outcomes in cultural industries.

Overall, the literature indicates three converging trends:

1. AI as a creativity amplifier (not replacement)
2. Batik as a digitally transformable cultural asset
3. Investment-driven AI adoption as a key enabler of innovation and market value

However, a major gap remains: existing studies rarely integrate AI investment, cultural design innovation, and value creation into a single conceptual framework. Most research remains fragmented across technological, cultural or business perspectives.

Conceptual Framework Logic

The conceptual framework of this study explains how **AI investment drives cultural design innovation in batik within the digital economy** through a sequential and capability-based process grounded in the Resource-Based View (RBV), Dynamic Capabilities Theory, and Cultural Capital Theory. From an RBV perspective, AI investment is conceptualised as a strategic organisational resource that includes financial capital, digital infrastructure, and AI-enabled design tools, which together form the foundation for competitive advantage in creative industries (Barney, 1991; Teece, 2007). Recent studies in AI-driven innovation further emphasise that such investments are not merely operational expenditures but strategic enablers of generative design capability and digital creativity in cultural and design-intensive sectors (Technovation, 2026; UNESCO, 2024).

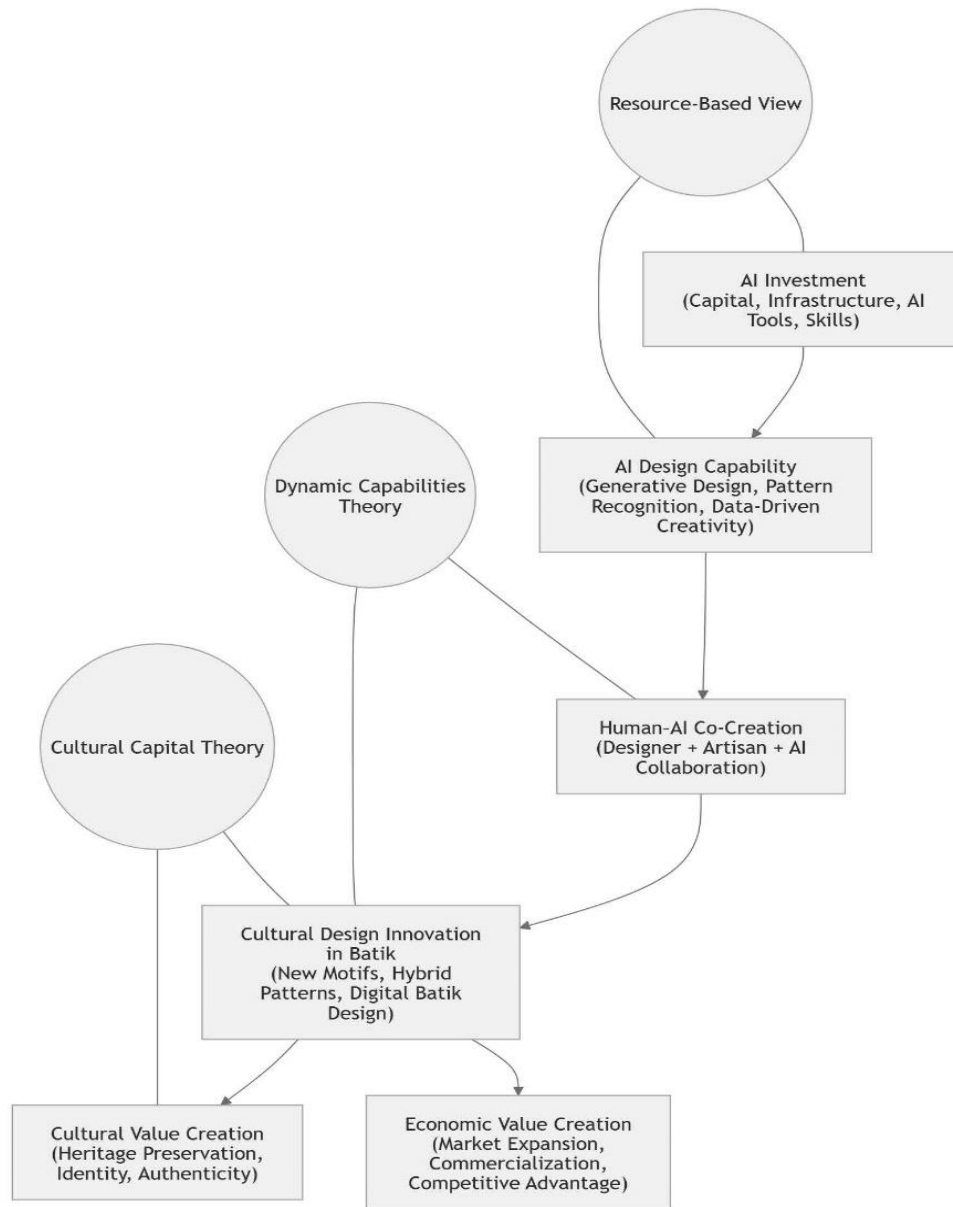


Fig. 2. AI Investment and Cultural Design Innovation: A Conceptual Framework for the Future of Batik in the Digital Economy

Building on this foundation, AI investment is expected to enhance **AI design capability**, which refers to the organisation’s ability to leverage machine learning systems, generative algorithms, and data-driven tools to support ideation, pattern generation, and design optimisation. This capability aligns with Dynamic Capabilities Theory, which highlights the importance of integrating, reconfiguring, and adapting organisational competencies in response to rapid technological change in the digital economy (Teece, 2007; Heigl et al., 2025). In the context of batik, AI design capability enables firms and designers to reinterpret traditional motifs and generate innovative design variations while maintaining cultural relevance.

The next stage of the framework involves **human–AI co-creation**, which represents the interactive collaboration between designers, artisans, and AI systems in producing batik designs. Recent literature on generative AI and creative collaboration suggests that AI functions as an active co-creative partner that expands ideation space and enhances creative exploration, rather than replacing human creativity (Sharma & Singhal, 2025; Singh et al., 2025). This co-creation process is particularly critical in heritage-based industries, where human cultural knowledge and symbolic interpretation must be integrated with computational design outputs to ensure cultural meaning and authenticity.

Human–AI co-creation subsequently leads to **cultural design innovation**, which refers to the development of new, hybrid, or digitally enhanced batik designs that combine traditional cultural elements with AI-generated

creative inputs. From the perspective of Cultural Capital Theory, batik design carries embedded symbolic, historical, and identity-based value that must be preserved even as it evolves through innovation processes (Bourdieu, 1986; UNESCO, 2024). Recent studies highlight that cultural design innovation in AI-enabled environments must balance technological novelty with cultural continuity to avoid homogenisation and loss of authenticity in heritage products (Creative Economy literature, 2025; Technovation, 2026).

Finally, cultural design innovation generates dual outcomes: **cultural value creation and economic value creation**. Cultural value creation refers to the preservation, reinforcement, and reinterpretation of cultural identity, authenticity, and heritage significance embedded in batik designs, while economic value creation refers to improved market performance, competitiveness, and commercialization potential in domestic and global markets. This dual-value outcome reflects recent findings in creative economy research, which argue that digital transformation and AI adoption increasingly enable cultural industries to simultaneously achieve cultural preservation and economic expansion (UNESCO, 2024; AI Index Report, 2024). Collectively, the framework demonstrates that AI investment does not directly produce value, but instead operates through a structured chain of capability development and co-creative processes that culminate in culturally meaningful and economically viable batik design innovation.

METHODOLOGY

Research Design and Conceptual Orientation

This study adopts a conceptual research design to develop a theoretical framework that explains the relationship between AI investment and cultural design innovation in the batik industry within the context of the digital economy. Unlike empirical studies that rely on primary data collection and statistical testing, conceptual research seeks to advance knowledge through the systematic integration, interpretation, and extension of existing theories and scholarly insights. The conceptual approach is particularly appropriate for emerging and interdisciplinary phenomena where theoretical understanding remains fragmented and empirical evidence is still evolving. In the context of this study, the intersection of artificial intelligence, cultural heritage, creative industries, and digital transformation represents a relatively underexplored area that requires theoretical consolidation to guide future research and practice.

The primary purpose of this study is not to test causal relationships empirically but to develop a coherent conceptual explanation of how AI investment can influence cultural design innovation and value creation in batik. Accordingly, the study adopts a theory-driven orientation that draws upon established theoretical perspectives, including the Resource-Based View (RBV), Dynamic Capabilities Theory, and Cultural Capital Theory. These theories provide complementary lenses for understanding how technological resources, organisational capabilities, and cultural assets interact to shape innovation outcomes. Through the integration of these theoretical perspectives, the study seeks to generate a comprehensive conceptual framework capable of explaining the mechanisms through which AI-enabled investments may contribute to the sustainability and competitiveness of heritage-based creative industries.

Literature Identification and Selection Process

The development of the conceptual framework was informed by a structured review of relevant academic literature. The literature identification process aimed to capture contemporary knowledge relating to artificial intelligence, design innovation, creative industries, cultural heritage, digital transformation, and value creation. To ensure broad coverage and academic quality, literature was sourced from established scholarly databases, including Scopus, Web of Science, ScienceDirect, SpringerLink, Emerald Insight, Taylor & Francis Online, and Google Scholar.

A series of keyword combinations was employed during the search process, including terms such as “artificial intelligence investment,” “generative AI,” “AI and creative industries,” “human–AI co-creation,” “cultural design innovation,” “batik digital transformation,” “creative economy,” “cultural heritage innovation,” and “value creation in creative industries.” The search focused primarily on literature published between 2020 and 2026 to reflect recent developments in generative AI technologies and digital transformation initiatives affecting

cultural and creative sectors. Earlier seminal works were also included where necessary to establish foundational theoretical perspectives.

The literature selection process involved several stages of screening. Initially, titles and abstracts were reviewed to determine relevance to the study objectives. Studies focusing exclusively on technical AI development without implications for innovation, design, culture, or creative industries were excluded. Full-text assessments were subsequently conducted to evaluate conceptual relevance, theoretical contribution, and applicability to the context of cultural design innovation. Priority was given to peer-reviewed journal articles, review papers, conceptual studies, and authoritative institutional reports that provided substantive insights into AI-enabled innovation, cultural creativity, and digital economy development. This systematic selection process ensured that the conceptual framework was grounded in current and credible scholarly evidence.

Conceptual Analysis and Synthesis

Following the literature selection stage, a conceptual analysis and synthesis process was undertaken to identify, compare, and integrate key constructs relevant to the study. The analysis began with a detailed examination of recurring concepts and theoretical arguments across the selected literature. Particular attention was given to identifying constructs that appeared consistently in discussions of AI-enabled innovation, creative capability development, cultural production, and value creation.

The identified concepts were subsequently grouped into broader thematic categories based on their conceptual similarities and theoretical relationships. Through an iterative comparison process, several core constructs emerged, including AI investment, AI design capability, human–AI co-creation, cultural design innovation, cultural value creation, and economic value creation. These constructs were then examined in relation to existing theoretical perspectives to establish their conceptual boundaries and explanatory roles within the proposed framework.

The synthesis process involved integrating insights from multiple disciplinary domains, including innovation management, strategic management, cultural studies, design research, and digital economy literature. The Resource-Based View was used to explain the strategic significance of AI investment as an organisational resource. Dynamic Capabilities Theory provided a basis for understanding how AI-enabled capabilities are developed and deployed to support innovation activities. Cultural Capital Theory contributed an understanding of how cultural meaning, authenticity, and heritage value influence innovation processes within traditional creative industries such as batik. Through this integrative approach, the study was able to establish theoretically grounded relationships among the identified constructs and develop a holistic understanding of AI-driven cultural innovation.

Conceptual Framework Development

The final stage of the methodology involved the development of the conceptual framework. This process was guided by the study's research objectives, which seek to explain how AI investment contributes to cultural design innovation and value creation in the batik industry. The framework was constructed by organising the synthesised constructs into a logical sequence that reflects the theoretical mechanisms identified in the literature.

The framework positions AI investment as the foundational strategic input that enables the development of AI design capability. AI design capability represents the organisation's capacity to utilise AI technologies for creative exploration, design generation, and innovation activities. Building upon this capability, the framework proposes that effective human–AI co-creation emerges through the interaction between designers, artisans, and intelligent systems. This collaborative process facilitates cultural design innovation by enabling the reinterpretation and enhancement of traditional batik motifs, patterns, and aesthetic expressions.

The framework further proposes that cultural design innovation generates two interconnected outcomes: cultural value creation and economic value creation. Cultural value creation refers to the preservation, revitalisation, and transmission of cultural identity and heritage, while economic value creation relates to market competitiveness, commercialisation opportunities, and industry growth within the digital economy. By linking these constructs within a coherent structure, the framework provides a theoretical explanation of how AI investment can support

both cultural sustainability and economic development in heritage-based creative industries. The resulting model serves as a foundation for future empirical investigation and offers a strategic perspective on the role of AI in shaping the future of batik innovation in the digital era.

CONCLUSION

This study develops a conceptual framework that explains how AI investment can drive cultural design innovation and value creation in the batik industry within the digital economy. The framework proposes that AI investment serves as a strategic enabler that strengthens AI design capability, facilitates human–AI co-creation, and ultimately supports cultural design innovation. Through this process, innovation generates both cultural value, in terms of heritage preservation and identity reinforcement, and economic value, through enhanced competitiveness, market expansion, and commercialization opportunities. The findings suggest that AI should not be viewed merely as a technological tool but as a long-term strategic investment capable of transforming traditional creative industries while maintaining their cultural significance.

The proposed framework is consistent with emerging literature that highlights the growing role of artificial intelligence in creative industries, design innovation, and digital transformation. Recent studies have demonstrated that AI technologies increasingly function as collaborative systems that augment human creativity rather than replace it, enabling designers to generate new ideas, accelerate design processes, and explore innovative creative possibilities. Similarly, research on cultural and creative industries has emphasized the importance of balancing technological innovation with cultural authenticity to ensure that heritage-based products remain meaningful and relevant in contemporary markets. By integrating these perspectives, the present study extends existing knowledge by linking AI investment directly to cultural design innovation through capability development and co-creation mechanisms.

Theoretically, this study contributes to the literature in several important ways. First, it extends the application of the Resource-Based View by conceptualising AI investment as a strategic resource that supports innovation and value creation in cultural industries. Second, it incorporates Dynamic Capabilities Theory to explain how organisations transform technological investments into innovation capabilities through adaptive and collaborative processes. Third, it enriches Cultural Capital Theory by illustrating how cultural heritage assets such as batik can be preserved and revitalised through AI-enabled innovation. The integration of these three theoretical perspectives provides a more comprehensive explanation of the relationship between technology, creativity, and cultural value than has been offered in previous studies.

From a practical perspective, the framework offers valuable insights for policymakers, creative industry practitioners, batik entrepreneurs, and technology developers. For policymakers, the model highlights the importance of supporting AI adoption and digital capability development within cultural and creative sectors. For batik producers and designers, the framework demonstrates how AI can be strategically leveraged to enhance design innovation, improve market responsiveness, and create new commercial opportunities while preserving cultural identity. Furthermore, the framework suggests that investments in digital skills, AI infrastructure, and collaborative innovation ecosystems may be critical for ensuring the long-term sustainability of heritage-based industries in increasingly digital and competitive environments.

Despite these contributions, several limitations should be acknowledged. First, the study is conceptual in nature and does not include empirical testing of the proposed relationships. As a result, the framework remains theoretical and requires validation through quantitative or qualitative research. Second, the framework is specifically developed within the context of batik and may not fully capture the unique characteristics of other cultural and creative industries. Third, the study primarily focuses on the positive potential of AI investment and does not examine in depth the ethical, legal, and governance challenges associated with AI-generated cultural content, including issues related to intellectual property, cultural appropriation, and authenticity.

Future research should therefore focus on empirically testing the proposed framework using data from batik enterprises, designers, creative entrepreneurs, and cultural organisations. Quantitative studies may examine the causal relationships among AI investment, AI capability development, co-creation, innovation, and value creation using structural equation modelling or similar analytical techniques. Qualitative investigations could further

explore how designers and artisans experience human–AI collaboration in practice and how cultural authenticity is negotiated within AI-assisted design processes. Comparative studies across different cultural industries and national contexts would also enhance understanding of how AI-enabled innovation operates within diverse cultural environments. Additionally, future research should examine the ethical and governance implications of AI adoption in heritage-based industries to ensure that technological advancement supports both cultural sustainability and responsible innovation.

In conclusion, this study provides a theoretically grounded framework for understanding the role of AI investment in shaping the future of batik within the digital economy. By integrating perspectives from strategic management, innovation studies, and cultural heritage research, the framework demonstrates that AI investment can contribute to both cultural preservation and economic development when supported by appropriate capabilities and collaborative design processes. As artificial intelligence continues to transform creative industries worldwide, the proposed framework offers a foundation for future scholarly inquiry and practical strategies aimed at ensuring that traditional cultural assets remain innovative, competitive, and culturally meaningful in the digital era.

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