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Socio-Tech Entrepreneurship Model: Empowering Tourism MSMEs through Digital Literacy and Collaborative Innovation

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ABSTRACT

Tourism micro, small, and medium enterprises (MSMEs) in rural destinations across Southeast Asia, including village-based tourism areas around Lake Toba, Sumatra, face compounding pressures from post-pandemic recovery and accelerating digital disruption. Existing evidence indicates that the digital divide confronting tourism MSMEs stems not from lack of technology access but from insufficient digital financial literacy and the absence of collaborative institutional networks. This study proposes a Socio-Tech Entrepreneurship Model (STEM) that integrates digital literacy and collaborative innovation as dual mechanisms for strengthening tourism MSME resilience and sustainability. Adopting a qualitative conceptual design grounded in a systematised literature review of nineteen peer-reviewed studies from Indonesian, Latin American, African, and European contexts, the study employs thematic synthesis across three interrelated themes: the digitalisation–innovation–sustainability chain in tourism MSMEs; the role of digital and financial literacy, including QRIS adoption, in ensuring business continuity and performance; and the contribution of collaborative and open innovation ecosystems to post-crisis recovery. The findings reveal that digital literacy and social capital are mutually constitutive, each necessary but insufficient without the other. The proposed model positions these dimensions as integrated inputs, with collaborative innovation as the primary mechanism and MSME resilience, sustainable performance, and destination-level sustainability as the intended outcomes. The study contributes a novel conceptual architecture grounded in dynamic capabilities theory, socio-technical systems thinking, and the tourism innovation ecosystem perspective, with practical implications for policymakers, destination managers, and academic institutions engaged in rural tourism MSME development across emerging economies.

Keywords: *Socio-Tech Entrepreneurship, Tourism MSMEs, Digital Financial Literacy, Collaborative Innovation, Sustainable Tourism*

1. INTRODUCTION

In rural tourism villages surrounding Lake Toba and across Southeast Asia, tourism MSMEs represent both the cultural backbone of local communities and their primary source of economic livelihood—yet their capacity to navigate the dual pressures of post-pandemic recovery and accelerating digital disruption remains critically underdeveloped. The COVID-19 pandemic exposed deep structural vulnerabilities within the hospitality and tourism industry, compelling enterprises to rapidly mobilize digital technologies as instruments of resilience and operational survival [1]. Within this landscape, MSMEs occupy a disproportionately significant position—constituting the backbone of most tourism ecosystems, particularly in emerging economies—while simultaneously bearing the greatest vulnerability to external shocks. Despite growing consensus on the importance of digital transformation, tourism has been notably slower to adapt, constrained by

resource limitations, organizational fragmentation, and governance uncertainty [2].

Research on small and medium-sized tourism enterprises has increasingly identified organizational adaptability, innovation, and digital transformation as critical pillars for sustainable post-crisis growth [3]. However, existing evidence suggests that the digital divide facing tourism MSMEs is not primarily a problem of technology access, but rather one of insufficient digital literacy—particularly in managing digital financial systems—and the absence of collaborative institutional networks. In the context of rural tourism villages such as those surrounding Lake Toba, the barrier to digital adoption is rarely the absence of technology infrastructure—it is the absence of the competencies and collaborative relationships needed to use these tools meaningfully. The fundamental challenge, therefore, is not technological but human and social.

Despite a growing body of scholarship, a substantive gap remains in integrating digitalisation, social capital, and collaborative innovation into a unified entrepreneurial framework for tourism MSMEs. Studies from Colombia and the Pacific Alliance confirm that digitalisation positively influences innovation and that sustainability mediates the innovation-performance relationship—yet direct pathways remain insufficiently validated where resource constraints act as barriers [4], [5]. Collaborative innovation research identifies cooperative networks and knowledge transfer as fundamental drivers of performance, yet these constructs are rarely studied alongside digital literacy considerations [6]. Similarly, while digital and financial literacy are acknowledged as critical for MSME business continuity—including QRIS adoption—these competencies are seldom situated within broader collaborative frameworks [7], [8]. While digital transformation [2], [4], [5] and Triple Helix models [16] address technical adoption and institutional collaboration respectively, no prior framework simultaneously integrates digital financial literacy (QRIS-specific), multi-level collaborative ecosystems, and rural tourism MSME resilience within Indonesia's digital payment ecosystem—a gap addressed by STEM.

Responding to this gap, this study proposes a Socio-Tech Entrepreneurship Model (STEM) integrating digital literacy and collaborative innovation as dual mechanisms for strengthening tourism MSME resilience and sustainability. Three research questions guide this study: (1) What is the role of digital literacy—including digital financial literacy—in building tourism MSME resilience? (2) How do multi-stakeholder collaborative networks facilitate innovation and adaptive capacity? (3) How can social and technical dimensions of entrepreneurship be integrated into a cohesive socio-tech framework?

This study contributes theoretically by proposing a novel conceptual architecture bridging socio-technical systems thinking with entrepreneurship scholarship. For policymakers and destination managers in village-based tourism areas—including those in the Lake Toba region—the model offers a practical roadmap: interventions should simultaneously strengthen digital financial competencies and cultivate multi-stakeholder collaborative networks through which those competencies can be sustained within local tourism ecosystems.

2. LITERATURE REVIEW

2.1. Tourism MSMEs, Digitalisation, and Sustainability

The relationship between digitalisation, innovation, and sustainability in tourism MSMEs has attracted growing scholarly attention. Evidence consistently demonstrates that digitalisation functions primarily as an enabler of innovation rather than a direct driver of performance. Research among Colombian tourism MSMEs confirms that digitalisation's positive influence on innovation capacity was significant, and innovation in turn demonstrated a meaningful impact on sustainability [4]. This indirect pathway is corroborated by multi-country evidence from the Pacific Alliance, where sustainability and digitalisation serve as mediating variables between innovation and MSME performance [5]. These findings suggest that the value of digital transformation lies not in technology adoption per se, but in its capacity to catalyse broader organisational learning.

The dynamic capabilities perspective offers a complementary lens: rather than treating digitalisation as a static resource, it is positioned as a dynamic capability through which SMTEs can sense opportunities, reconfigure operations, and sustain competitiveness [3]. Evidence from tourism MSMEs in Jambi Province, Indonesia, reinforces this argument, identifying business digitisation, supply chain management, and government-assisted capacity building as three converging recovery strategies [9]. Nevertheless, significant inconsistencies persist between policy-level advocacy for digital transformation and its actual uptake among MSMEs, where resource constraints and low organisational capabilities create structural barriers [2]. Scenario analysis from the Canary Islands similarly identifies business culture and knowledge limitations as critical uncertainties constraining digital transformation [10]. These findings establish a clear consensus: digitalisation holds transformative potential, but its realisation depends on addressing human, organisational, and institutional conditions—a dimension explored in the following section

2.2. Digital and Financial Literacy in Tourism MSMEs

Digital and financial literacy constitute the individual-level competencies through which tourism MSMEs can meaningfully participate in digital transformation. Research in the Taman Kalong tourist area, Soppeng Regency, Indonesia, demonstrates that both financial and digital literacy play a significant role in supporting business continuity [7]. A mixed-methods study of MSMEs at Pancer Puger Beach, Jember, reveals that digital financial literacy not only directly affects financial performance but also shapes financial behaviour, establishing a literacy–behaviour–performance pathway with important implications for capacity-building programme design [8]. Structured training in social media use and electronic transaction regulations in Surakarta further enhanced tourism MSME actors' capacity for digital promotion and governance [11]. Research in the culinary tourism setting of Makassar finds that digital financial literacy, socioeconomic status, and digital lifestyle all positively influence QRIS adoption, with technology acceptance serving as a critical mediating variable [12]. Critically, however, digital literacy interventions are frequently implemented as standalone programmes, disconnected from the collaborative networks that would sustain their application—a fragmentation that points directly to the need for an integrated framework embedding literacy within a broader collaborative ecosystem.

2.3. Collaborative Innovation and Socio-Technical Ecosystems

Collaborative innovation—the process through which tourism MSMEs engage external actors to generate and apply knowledge—functions as the primary institutional mechanism for overcoming individual capability constraints. Systematic review evidence identifies five principal collaborative research clusters: cooperative firm behaviour, co-creation, collaborative networks, knowledge transfer, and innovation policy [6]. Open innovation is particularly germane: by opening organisational boundaries to external knowledge flows, tourism MSMEs can access resources and expertise that would otherwise be inaccessible given their scale constraints [13], [14]. The rural tourism innovation ecosystem literature maps the heterogeneous actors—government agencies, academic institutions, community organisations, and private enterprises—whose knowledge exchanges constitute the enabling environment for innovation, noting that these actors play both enabling and hindering roles [15]. The Triple Helix model has been operationalised in tourism contexts in Tanzania and The Gambia with demonstrable effects on networking and knowledge transfer [16]. In Indonesia, quantitative evidence from Rembang and Banyuwangi confirms that open innovation, stakeholder participation, and support system facilities significantly improve tourism performance and sustainability [14]. Post-pandemic evidence further confirms that enterprises leveraging network technologies within collaborative stakeholder frameworks achieved more comprehensive sustainability outcomes than those pursuing digital adoption in isolation [1]. Despite this evidence, active governance of multi-stakeholder collaboration remains underspecified—few existing models address how social and technical dimensions can be managed simultaneously.

2.4. Conceptual Challenges and Towards a Socio-Tech Model

Several conceptual challenges limit the development of an integrated framework. First, structural barriers to digital transformation in developing economies stem primarily from cultural factors—low risk tolerance, preference for informal business practices, and limited trust in digital financial systems—rather than technology access deficits [2], [10]. Second, the literature has not adequately theorised project-based entrepreneurship as an innovation mechanism: collaborative, time-bound initiatives such as joint QRIS adoption campaigns or co-designed marketing programmes generate shared learning and network capital that persists beyond individual projects [15]. Third, while dynamic capabilities theory [3], open innovation frameworks [13], [14], and digital literacy models [7], [8] each offer partial explanations, they have not been synthesised into an integrated socio-technical entrepreneurship model. Socio-technical systems theory—which argues that sustainable transitions require simultaneous alignment of social structures and technological systems [17] — provides the unifying lens, positioning digital literacy and social capital as interdependent dimensions of a single entrepreneurial system.

The preceding review reveals a literature rich in individual insights yet fragmented in overall architecture. Scholarship has established the digitalisation–innovation–sustainability chain but has not theorised digital financial literacy as its prerequisite [4], [5]. Digital literacy research has demonstrated the literacy–behaviour–performance pathway but treats literacy as isolated rather than systemic [7], [8], [11]. Collaborative innovation literature has mapped structural conditions but rarely connects them to specific literacy gaps [6], [14], [15]. While individual elements exist across adjacent literatures (digitalisation-innovation chains [4], [5], collaborative networks [6], [14], digital literacy

pathways [7], [8]), no prior framework simultaneously integrates digital financial literacy (including QRIS adoption), multi-stakeholder collaborative ecosystems, and tourism MSME resilience specifically within rural destination contexts—the contribution of the proposed STEM model.

Digital transformation literature establishes innovation chains [4], [5]; Triple Helix models map institutional collaboration [16]; open innovation frameworks address knowledge flows [14]. STEM distinguishes itself by simultaneously integrating: (1) QRIS-specific digital financial literacy [7], [8], [12]; (2) multi-level network orchestration (firm-ecosystem-destination) [6], [15]; (3) rural tourism MSME resilience outcomes within Indonesia's national digital payment infrastructure—yielding a contextually-grounded practical framework absent from existing integrations.

3. METHOD

3.1. Research Design

This study adopts a qualitative conceptual research design grounded in a systematised literature review. Rather than generating primary empirical data, the study synthesises existing scholarly evidence to construct a conceptual framework—an approach well-established when the primary objective is theoretical model development [3], [6]. The design comprises two integrated components: a systematised review of literature on digital literacy, collaborative innovation, and tourism MSME sustainability; and an interpretive conceptual analysis through which synthesised evidence identifies theoretical gaps and informs the proposed STEM framework [2], [15].

3.2. Literature Review Procedure

Literature was identified through searches of Scopus, Web of Science, and Google Scholar using keyword combinations including: *tourism MSMEs*, *digital literacy*, *digital financial literacy*, *QRIS*, *collaborative innovation*, *open innovation*, *sustainable tourism*, *MSME resilience*, and *post-pandemic tourism recovery*. The search spanned 2004-2025, yielding 1,247 initial records.

Three-stage screening refined the corpus: (1) title/abstract screening eliminated duplicates and irrelevant topics (n=187 retained); (2) full-text eligibility assessment applied four explicit inclusion criteria: studies must address tourism/hospitality sectors, focus on MSMEs/SMTEs, engage substantively with digitalisation/digital literacy/collaborative innovation/sustainability, and be peer-reviewed (n=47 eligible); (3) quality appraisal assessed each study for methodological transparency (clear methods/data sources), contextual relevance (tourism MSME applicability), and theoretical contribution to core constructs using a 3-point scale (high/medium/low).

Nineteen peer-reviewed articles met all quality thresholds, forming the primary evidence base. The focused corpus reflects the emerging nature of this interdisciplinary domain at the intersection of digital literacy, collaborative innovation, and tourism MSME sustainability—justifying the present model-building effort.

Table 2 summarises the quality appraisal outcomes: 12 studies scored 9/9 (high), 6 scored 8/9 (high), 1 scored 7/9 (medium).

Table 2. Quality Appraisal Summary (n=19 studies)

Score	Number of Studies	%	Decision
9/9	12	63%	Include
8/9	6	32%	Include
7/9	1	5%	Include
<7	0	0%	Excluded

3.3. Data Analysis and Validity

The analytical process followed an interpretive thematic synthesis approach [18], [19] proceeding in three stages. First, each study was coded for key themes: barriers and enablers of digital and financial literacy; forms and quality of multi-stakeholder collaboration; digitalisation–innovation relationships; and socio-technical alignment patterns. Second, initial codes were clustered into higher-order thematic categories through cross-study synthesis. Third, synthesised themes were interpreted against dynamic capabilities theory, socio-technical systems theory, and the innovation ecosystem perspective to identify conceptual gaps. To strengthen trustworthiness, source triangulation was applied throughout—cross-checking claims across geographically and methodologically diverse studies from Latin America [4], [5], Indonesia [7], [8], [11], and international systematic reviews [2], [6], [15]. An inter-researcher discussion process was applied at the clustering stage to minimise interpretive bias [19].

4. FINDINGS AND DISCUSSION

Table 3. Research Questions, Findings, and Theoretical Linkages

Research Question	Key Finding	Critical Mechanism	Theoretical Linkage
RQ1: Role of digital literacy in MSME resilience	Digital financial literacy enhances business continuity through behavioural mediation	Technology acceptance mediates QRIS adoption; financial behaviour links literacy→performance	Dynamic capabilities: financial behaviour as 'seizing' mechanism
RQ2: How collaborative networks facilitate innovation	Networks overcome individual constraints via knowledge transfer and co-creation	Stakeholder interdependence drives performance more than environmental competitiveness alone	Innovation ecosystem: network orchestration capability

RQ3: Integration of social and technical dimensions	Social capital amplifies digital competencies producing system-level resilience	Co-evolutionary alignment of socio-technical dimensions	Socio-technical systems theory + STEM model

Table 2 maps research questions to findings, mechanisms, and theory. The following themes respond directly to the three research questions. Theme 1 addresses RQ1 by critically examining evidence on digital literacy as a foundational but frequently fragmented capability. Theme 2 addresses RQ2 by analysing the conditions under which collaborative networks facilitate—or fail to facilitate—innovation and adaptive capacity. Theme 3 addresses RQ3 by synthesising how the social and technical dimensions interact to produce resilience outcomes. Critically, the evidence across all three themes consistently challenges the assumption that technology provision alone drives MSME resilience—a finding with significant implications for how digital transformation programmes are designed and evaluated in emerging economy tourism contexts.

4.1. Theme 1 – Digital Literacy as Mediated Capability (RQ1)

Table 2 (RQ1) shows digital literacy works indirectly through behavioural mediation [7], [8], [12]. QRIS adoption requires technology acceptance (not just knowledge) [12]; financial behaviour links literacy to performance [8].

This pathway extends dynamic capabilities [3]: financial behaviour enables MSMEs to 'seize' digital opportunities. Adoption models fail because they ignore mediation—explaining persistent gaps between infrastructure availability and effective utilisation [2], [10].

Pacific Alliance confirms context moderates effectiveness [5]. Digital literacy constitutes necessary but insufficient resilience antecedent—requiring network support (Theme 2).

4.2. Theme 2 – Network Effects in Collaborative Innovation (RQ2)

Table 2 (RQ2) reveals collaborative networks overcome individual MSME constraints through five mechanisms [6]: co-creation, knowledge transfer, network access, Triple Helix partnerships [16], and open innovation [14]. Indonesian evidence shows stakeholder interdependence significantly outperforms environmental competitiveness alone in explaining performance outcomes [14].

Networks function as 'orchestration capability'—coordinating diverse actors toward shared resilience goals beyond firm-level innovation [6], [15]. Triple Helix succeeds because universities anchor capacity building while associations facilitate peer learning [16].

Individual digital competencies (Theme 1) require network amplification to scale resilience impact.

4.3. Theme 3 – Indirect Pathways to Resilience and Sustainability (RQ3)

Table 2 (RQ3) confirms digitalisation → resilience pathways are indirect and mediated: digitalisation → innovation → sustainability → performance [4], [5]. Dynamic capabilities explain this: MSMEs must sense market changes, seize via innovation, reconfigure operations [3].

Enterprise resilience emerges from ecosystem interdependence [15]. Well-networked MSMEs absorb shocks better than isolated digital adopters. Mediation chain strength varies by institutional context—stronger in supportive environments [5]. However, mediation chain effectiveness remains contingent on institutional quality—destinations with weak governance structures risk digital investments yielding minimal resilience returns [2], [10].

Themes 1-2 converge in co-evolutionary socio-technical alignment [17]. Digital literacy (RQ1) + network orchestration (RQ2) → system-level resilience. STEM model (Figure 1) formalises this architecture for rural tourism MSMEs.

4.4. Proposed Socio-Tech Entrepreneurship Model

Drawing on Themes 1-3 synthesis, this study proposes the Socio-Tech Entrepreneurship Model (STEM) structured around four mutually reinforcing components formalised in Figure 1.

Socio dimension encompasses social capital and institutional structures: multi-stakeholder collaborative networks linking entrepreneurs, government, academia, and private partners; inclusive governance ensuring equitable participation; community leadership anchoring local knowledge; formal/informal support systems [13], [14], [15], [16].

Tech dimension spans digital competencies at two levels. Operationally: platform proficiency, social media content creation, electronic transaction familiarity [11]. Strategically: digital financial literacy, QRIS adoption/management, digital platforms for market development [8], [12] —sustained through collaborative structures [2], [7].

Entrepreneurial processes integrate dynamic activities: opportunity recognition via dynamic capabilities [3]; collaborative innovation through co-creation/knowledge transfer [6], [13]; business model innovation critical for post-crisis recovery [1], [9]; and

capacity building via training/mentoring sustaining all processes [7], [11].

Outcomes operate at three levels: enterprise-level MSME resilience; sector-level sustainable performance across economic/social/environmental dimensions [1], [4]; and destination-level smart tourism aligned with the UN Sustainable Development Goals [2].

Unlike Technology Acceptance Model (individual attitudes) or Triple Helix model (inter-institutional collaboration), STEM simultaneously integrates individual digital competencies (RQ1), network orchestration capabilities (RQ2), and co-evolutionary socio-technical alignment (RQ3) within rural tourism MSME contexts. This provides policymakers and destination managers with an implementable framework: digital transformation programmes must simultaneously deliver literacy training and ecosystem facilitation to achieve scalable resilience outcomes.

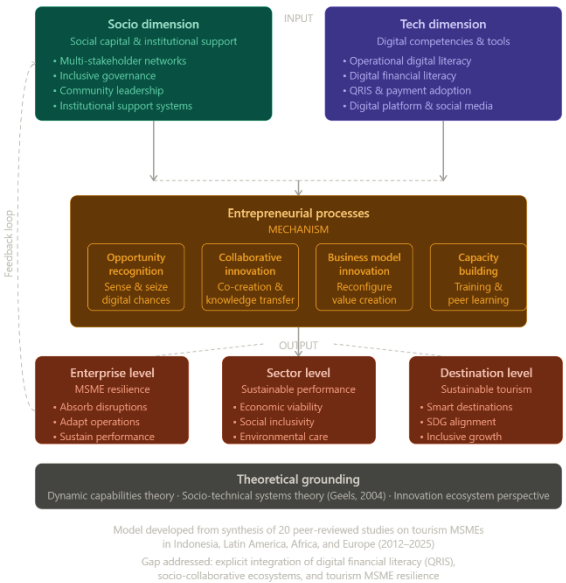


Figure 1. Socio-Tech Entrepreneurship Model (STEM) for Tourism MSME Resilience and Sustainability

5. CONCLUSIONS

This study addressed a substantive gap in the tourism entrepreneurship literature by proposing the Socio-Tech Entrepreneurship Model (STEM), grounded in a synthesis of nineteen peer-reviewed studies spanning Indonesian, Latin American, African, and European tourism MSME contexts. The model positions digital literacy—including digital financial competencies such as QRIS adoption—and social capital—operationalised through multi-stakeholder collaborative networks—as mutually constitutive inputs, with collaborative and open innovation as primary mechanisms generating resilient and sustainable tourism enterprise outcomes. In doing so, it integrates previously fragmented literatures on digitalisation, digital financial literacy, collaborative innovation, and rural tourism innovation ecosystems into a single coherent architecture— representing a context-specific integration of previously fragmented literatures tailored for rural tourism MSMEs in emerging economies, particularly Indonesia's QRIS-enabled digital ecosystem and is explicitly proposed as a framework for future empirical validation.

The theoretical contribution is threefold. First, the study advances socio-technical systems theory into the tourism entrepreneurship domain by demonstrating that the co-evolutionary alignment of social capital and digital competencies constitutes the foundational condition for sustainable MSME development. Second, it extends the dynamic capabilities framework by specifying digital financial literacy as a critical but previously undertheorised capability. Third, it introduces project-based entrepreneurship as a conceptual bridge between individual enterprise capability and ecosystem-level innovation.

The practical implications are directly relevant to policymakers and destination managers engaged in rural tourism development—particularly in village-based destinations such as those in the Lake Toba region, which represent a relevant setting for future empirical application. For policymakers, digital economy programmes should bundle technical literacy training with collaborative network facilitation. For destination managers, multi-stakeholder tourism development forums should jointly identify capability gaps and co-design interventions built on open innovation principles. For academic institutions, project-based entrepreneurship modules centred on real-world challenges such as QRIS adoption should be embedded within tourism curricula.

This study is not without limitations. As a qualitative conceptual study, the proposed model requires empirical validation before causal claims can be made. Future research should prioritise testing the STEM framework using structural equation modelling or partial least squares methods across multiple tourism destinations—with Indonesian village-based destinations, including those in the Lake Toba region, representing particularly relevant settings. Longitudinal designs are further needed to examine how digital literacy interventions and collaborative network participation cumulatively influence MSME resilience over time. Comparative studies across rural village tourism, coastal, and urban culinary tourism contexts would additionally enable contextual adaptation of the model, strengthening its generalisability across the diverse landscape of Indonesian and Southeast Asian tourism development.

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