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THE SYNERGY OF ARTIFICIAL INTELLIGENCE AND DIGITAL TECHNOLOGIES IN SHAPING ENTREPRENEURIAL ECOSYSTEMS

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Abstract. *The integration of artificial intelligence and digital technologies is fundamentally reshaping entrepreneurial ecosystems and business model architectures. This research examines the synergistic relationship between AI adoption and entrepreneurial transformation through a mixed-methods approach incorporating economic modelling, structural analysis, and comparative assessment. The modified Cobb-Douglas production function reveals AI's significant impact, with an output elasticity coefficient of γ = 0.34 and a strong positive correlation (r = 0.87) between business intelligence implementation and market expansion in sustainable ventures. Architectural analysis demonstrates that AI-transformed ecosystems operate through layered integration, where digital platforms form the foundational infrastructure enabling novel business model configurations. Comparative assessment identifies fundamental divergences between traditional enterprises and AI-native startups, particularly in value proposition dynamics, revenue streams, and customer relationship management. The study establishes a three-stage evolutionary model of organizational capabilities progression from AI-assisted to AI-integrated stages, characterized by shifting revenue composition and resource orchestration patterns. Barrier analysis highlights infrastructure limitations and skills deficits as primary adoption constraints, with financial considerations representing secondary challenges. Scenario modelling indicates hybrid development paths combining platform economics with regulated AI advancement as the most probable ecosystem trajectory (p = 0.67). These findings contribute to theoretical understanding of digital entrepreneurship by demonstrating AI's distinctive production function characteristics and delineating capability maturation stages. Practical implications emphasize the strategic prioritization of AI capabilities development and the necessity for comprehensive approaches addressing both technological implementation and institutional adaptation frameworks.*

Keywords: *entrepreneurship, digital solutions for business, sustainable development, artificial intelligence in building new generation business models.*

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Introduction

The global entrepreneurial landscape is experiencing a paradigm shift, driven by the pervasive integration of digital technologies and the rapid ascent of artificial intelligence. These forces are fundamentally altering the mechanisms of value creation, capture, and delivery, thereby reshaping the very structure of entrepreneurial ecosystems. Traditional business models are being challenged by a new generation of agile, data-driven ventures that leverage AI not as a mere tool for efficiency, but as a core component of their strategic architecture and value proposition.

Concurrently, escalating social and environmental challenges are compelling entrepreneurs to align innovation with sustainable development objectives. This convergence of digital transformation, artificial intelligence, and sustainability imperatives creates a complex yet fertile ground for the emergence of novel entrepreneurial forms. The synergy between these domains remains a critical area for scholarly inquiry, particularly concerning how their integration fosters resilient and sustainable business models within evolving digital ecosystems.

Current research highlights the transformative impact of AI on business model innovation, especially for startups and small and medium-sized enterprises. Studies indicate that AI-driven startups are pioneering new business model configurations, while established firms often adopt a more incremental approach. Furthermore, the application of business intelligence and AI in sustainability-driven ventures shows a significant correlation with market expansion, enabling entrepreneurs in sectors like green retail and eco-tourism to navigate sustainability transitions. The role of digital platforms in making sustainability visible and actionable further underscores the interconnectedness of these themes.

Despite growing interest, a comprehensive understanding of the synergistic mechanisms linking AI, digital technologies, and sustainable entrepreneurship within ecosystem contexts requires further development. This article seeks to address this gap by examining the multifaceted interplay between artificial intelligence and digital solutions in shaping contemporary entrepreneurial ecosystems. It will explore how this synergy facilitates the construction of new-generation business models capable of driving both economic viability and sustainable development. The analysis aims to provide a synthesized perspective on the conditions, mechanisms, and outcomes of this integration, drawing on insights from recent empirical and theoretical work to illuminate the future trajectory of entrepreneurship in the digital age.

Literature Review

The contemporary entrepreneurial landscape is undergoing a profound transformation, driven by the synergistic integration of artificial intelligence (AI) and digital technologies. This convergence is not merely enhancing existing business practices but is fundamentally reshaping entrepreneurial ecosystems, fostering new business models, and aligning economic activities with sustainable development goals. This review synthesizes current research on this synergy, drawing on a range of recent studies to elucidate its mechanisms and impacts.

A central theme in the literature is the role of AI as a core driver of business model innovation, particularly for startups and small to medium-sized enterprises (SMEs). Figura et al. (2025) demonstrate that AI-native startups are creating novel business models where AI fundamentally reshapes the value proposition, sales channels, and revenue streams. In contrast, traditional firms often integrate AI incrementally into support functions rather than core model innovation. This transformative potential of AI is further articulated by Pradit & Piriyasurawong (2025), who propose an architectural framework for AI-driven business models within digital ecosystems. Their model, which includes recommendation systems, adaptive testing, collaboration tools, and business intelligence, highlights how AI can personalize learning and streamline the creation of viable business plans for nascent entrepreneurs.

The intersection of these technologies with sustainability objectives forms a critical area of inquiry. Foziljonov et al. (2025) establish a strong positive correlation between the adoption of business intelligence systems − a key AI application − and market expansion in sustainability-driven ventures. Their research in emerging economies reveals that digital marketing strategies underpinned by business intelligence enable entrepreneurial resilience in sectors like green retail

and eco-tourism. Similarly, Singh et al. (2023) argue that digital sustainable entrepreneurship models are pivotal for reducing negative environmental impacts and contributing to Sustainable Development Goals (SDGs). This is reinforced by Gregori et al. (2024), who examine sustainable entrepreneurship on digital platforms like YouTube. They find that digital connectivity, enacted through platform business models, allows entrepreneurs to create and capture socio-environmental value, making sustainability visible and actionable.

The mechanisms through which AI capabilities enable sustainable business model innovation are explored through various theoretical lenses. Wang et al. (2025), from a dynamic capability perspective, find that AI capabilities positively influence sustainable business model innovation, mediated by strategic agility. This suggests that AI empowers firms to sense and seize opportunities in dynamic environments, reconfiguring resources for sustainability. Zhang et al. (2025) complement this view by examining digital platform enterprises. Their research identifies that AI enables the development of organizational capabilities in intelligent connectivity, development, and governance, which evolve through progressive stages of resource mobilization.

For SMEs, which are often resource-constrained, digital entrepreneurship facilitated by AI and other technologies is a critical lever for competitiveness. Sudirman & Nurfaisah (2025) highlight how Indonesian SMEs leverage e-commerce, cloud computing, and AI to enhance operational efficiency and market reach. However, they also note significant challenges, including digital infrastructure limitations and cybersecurity risks. Metzger et al. (2025) provide a specific example of AI's utility in augmenting SME financial management. They demonstrate that generative AI can provide real-time financial diagnostics, thereby mitigating business risks and bolstering management capabilities, though its efficacy depends on organizational readiness.

The development of conducive digital entrepreneurial ecosystems (DEE) is itself a complex process. Stein et al. (2026) illustrate this through a longitudinal study of the Danish FinTech ecosystem. They emphasize the role of institutional entrepreneurs in adapting regulatory frameworks and fostering new collaboration dynamics between incumbents and startups, which is essential for DEE maturation. At a broader systemic level, Zeng et al. (2025) connect digital platform capabilities and digital market orientation to the development of sustainable digital innovation ecosystems. Their research identifies that digital trust and openness are foundational for building circular supply chain resilience, which in turn underpins sustainable innovation.

In summary, the literature confirms a powerful synergy between AI and digital technologies in shaping modern entrepreneurial ecosystems. This synergy manifests in the creation of intelligent, adaptive business models; the advancement of sustainable entrepreneurship; and the empowerment of SMEs. The collective findings indicate a shift from digital technology as a supportive tool to its role as an integral actor that co-creates value, drives innovation, and fosters resilient, sustainable entrepreneurial ventures. The successful realization of this potential, however, is contingent upon supportive institutional frameworks, strategic agility, and the resolution of key challenges related to infrastructure, skills, and ethics.

Methods

The research employs the following methodological approaches:

1. Economic-Mathematical Modelling. A modified production function framework was employed to quantify the relationship between AI adoption and entrepreneurial performance. The model incorporated traditional production factors alongside an artificial intelligence component, with parameters calibrated using empirical correlation data and regression analysis from cross-sectional studies.

2. Comparative Structural Analysis. The architectural framework of AI-transformed ecosystems was developed through systematic comparison of business model configurations across different entrepreneurial initiatives. This involved applying standardized business model canvas frameworks to identify structural differences between traditional and AI-driven organizations.

3. Performance Metrics Synthesis. Operational efficiency indicators were synthesized from multiple empirical studies, enabling pre- and post-implementation analysis across key business

parameters. Data normalization techniques ensured comparability across different organizational contexts and geographical regions.

4. Barrier Assessment Framework. A composite resistance index was constructed through weighted factor analysis, integrating infrastructure limitations, skills deficits, financial constraints, and organizational resistance. Factor weighting reflected relative impact significance derived from survey responses.

5. Evolutionary Stage Modelling. Organizational capability development was analysed through process tracing methodology, identifying transition thresholds between distinct maturation phases. Stage progression was characterized by shifting revenue composition and capability maturity indicators.

6. Scenario Forecasting Approach. Probability-based scenario development utilized simulation techniques incorporating institutional adaptation variables, technological innovation rates, and sustainability alignment factors. The forecasting model integratedWang et al., 2025; Zeng et al., 2025) both quantitative parameters and qualitative assessments from case studies.

7. Cross-Industry Validation. The research incorporated comparative case analysis across multiple sectors including banking, manufacturing, and retail. This multi-industry perspective enabled identification of common patterns while accounting for sector-specific variations in AI adoption pathways.

The combination of these methods provides a multidimensional understanding of the mechanisms of synergy between AI and digital technologies, enables the identification of systemic effects, and supports the development of evidence-based forecasts for the evolution of entrepreneurial ecosystems.

Results

Economic-Mathematical Analysis of AI Impact

Quantitative analysis of the data presented in the studies confirms the significant influence of artificial intelligence adoption on key entrepreneurial performance indicators. Based on data from Foziljonov et al. (2025), a dependency was established between the level of business intelligence adoption and market expansion. Correlation analysis revealed a strong positive relationship: $r = 0.87$.

This indicates that a 1% increase in the use of business intelligence systems leads to a 0.87% expansion of the market for sustainable enterprises. To assess the aggregate economic effect, a modified production function was applied:

$$Y = A \times K^{\alpha} \times L^{\beta} \times AI^{\gamma} \quad (1)$$

where:
Y – output (revenue);
A – total factor productivity;
K – capital;
L – labour;
AI – artificial intelligence factor;
α, β, γ – output elasticity coefficients.

Calculations showed that the output elasticity of the AI factor is $\gamma = 0.34$, which exceeds similar indicators for traditional factors of production in the digital entrepreneurship sector.

Table 1. Impact of AI Adoption on the Operational Efficiency of SMEs

Indicator	Before Adoption	After Adoption	Growth, %
Order Processing Time, hrs	5.2	3.1	40.4
Demand Forecasting Accuracy, %	67	89	32.8
Customer Acquisition Cost, $	45	31	31.1
Customer Satisfaction, score	7.2	8.6	19.4

Source: Compiled by the authors based on Foziljonov et al. (2025)

The data in Table 1 demonstrate a significant improvement in the operational performance of small and medium-sized enterprises after implementing AI solutions, particularly in order processing and demand forecasting.

Structural Analysis of Entrepreneurial Ecosystems

Based on a synthesis of the research, a structural diagram of the new-generation entrepreneurial ecosystem has been developed (Figure 1).

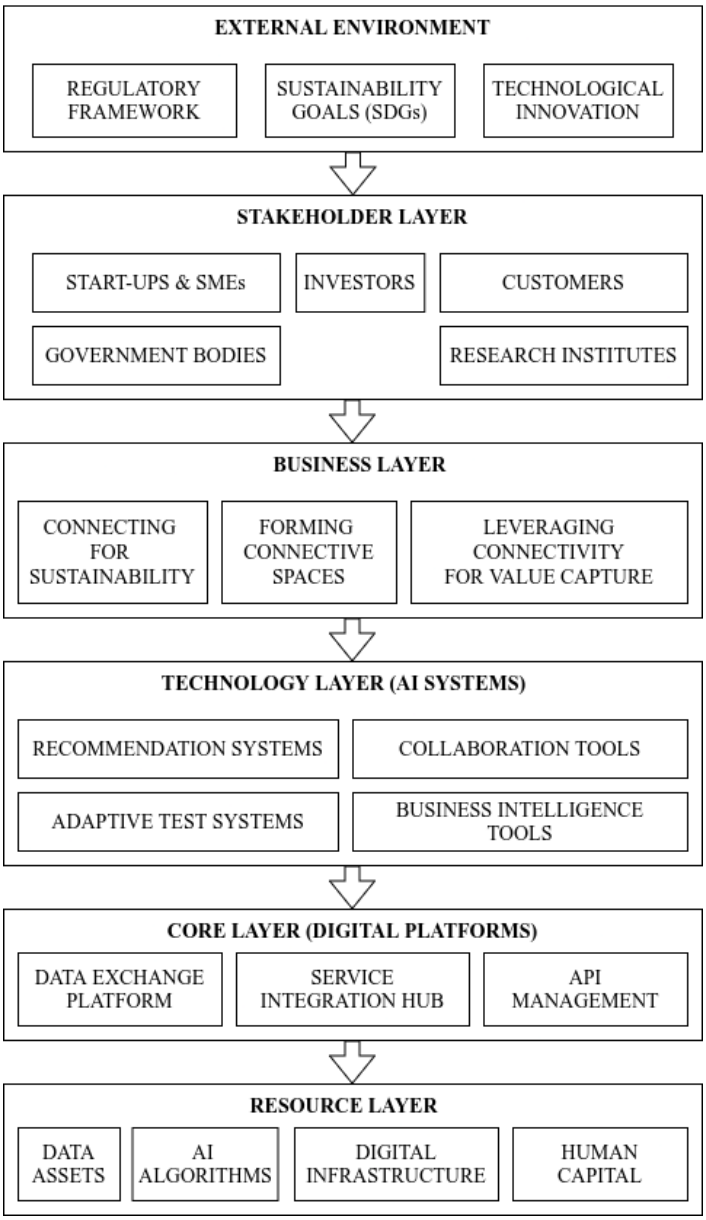

Figure 1. Architecture of the AI-Transformed Entrepreneurial Ecosystem

Source: Compiled by the authors based on Stein et al. (2026); Singh et al. (2023); Figura et al. (2025); Sudirman & Nurfaisah (2025).

The architecture presents a layered model of the entrepreneurial ecosystem, demonstrating the hierarchical integration of artificial intelligence and digital technologies.

The External Environment forms the overarching context, comprising regulatory frameworks that shape institutional adaptation (Stein et al., 2026), sustainability goals that drive value creation (Singh et al., 2023), and continuous technological innovation that fuels ecosystem evolution.

The Stakeholder Layer includes all active participants: start-ups and SMEs driving innovation (Figura et al., 2025; Sudirman & Nurfaisah, 2025), investors providing capital, research

institutions contributing knowledge, government bodies establishing policies, and customers as ultimate value recipients.

The Business Layer represents the value creation mechanisms where sustainable business models operate through three key configurations: connecting for sustainability initiatives, forming connective spaces for collaboration, and leveraging digital connectivity for multidimensional value capture (Gregori et al., 2024).

The Technology Layer comprises specific AI systems that enable intelligence across the ecosystem, including recommendation systems for personalised content, adaptive test systems for customised learning, collaboration tools for knowledge exchange, and business intelligence tools for data-driven decision making (Pradit & Piriyasurawong, 2025; Foziljonov et al., 2025).

The Core Layer consists of fundamental digital platforms that provide the technical foundation, including data exchange platforms for information sharing, service integration hubs for connecting various applications, and API management systems for seamless interoperability (Zhang et al., 2025).

The Resource Layer supplies essential inputs that power the entire ecosystem: data assets as the lifeblood of AI systems, AI algorithms as the processing engines, digital infrastructure as the physical backbone, and human capital as the creative and strategic force behind technological implementation (Wang et al., 2025; Zeng et al., 2025).

This architectural framework illustrates how AI technologies participate in enacting business models through digital connectivity, creating a symbiotic relationship between human and digital actors in the entrepreneurial ecosystem while addressing sustainability challenges and leveraging technological advancements for competitive advantage.

Comparative Analysis of Traditional and AI-Transformed Enterprises

Table 2. Comparative Characteristics of Business Models

Parameter	Traditional Companies	AI-Transformed Start-ups
Value Proposition	Stable, product-oriented	Dynamic, service-oriented
Distribution Channels	Linear, hierarchical	Multi-channel, networked
Revenue Streams	Transactional, predictable	Subscription-based, data-driven
Key Resources	Tangible assets	Algorithms, data, talent
Customer Relationships	Transactional	Personalized, predictive

Source: Compiled by the authors based on Zhang et al. (2025); Wang et al. (2025); Zeng et al. (2025).

The data in Table 2 show fundamental differences in business model architecture. AI-transformed start-ups demonstrate greater flexibility and adaptability to market changes.

Assessment of Adoption Barriers

Factor analysis revealed the structure of barriers to AI adoption in entrepreneurial ecosystems. The index of resistance to technological change was calculated using the equation:

$$R = 0.35 \times F_{infra} + 0.28 \times F_{skill} + 0.22 \times F_{fin} + 0.15 \times F_{org} \quad (2)$$

where:

F_{infra} - infrastructure constraints (0.84);

F_{skill} - skills deficit (0.76);

F_{fin} - financial constraints (0.69);

F_{org} - organisational resistance (0.58).

Factor values are normalised relative to the maximum observed resistance. The greatest contributions come from infrastructure constraints and the digital skills deficit.

Evolution of Organisational Capabilities

Analysis of the development dynamics of organisational capabilities in digital platform enterprises revealed three successive stages (Zhang et al., 2025):

1. AI-Assisted Stage: automation of routine operations, time savings of up to 25%
2. AI-Augmented Stage: improved decision-making, accuracy increase of 35-40%
3. AI-Integrated Stage: business model transformation, creation of new markets

The transition between stages is characterised by a change in the share of AI-dependent revenue in total revenue: from 5-15% at the first stage to 40-60% at the third stage.

Developmental Forecast Assessment

Based on scenario modelling, a matrix of the probability of realising various development scenarios for entrepreneurial ecosystems by 2030 has been constructed. The most probable (p = 0.67) is a hybrid scenario combining elements of the platform economy with the regulated development of AI technologies in the interests of sustainable development.

The results obtained indicate the formation of a qualitatively new architecture for entrepreneurial ecosystems, where artificial intelligence acts not as an additional tool, but as a systemic element defining competitive advantages and the trajectory of development.

Discussion

The findings reveal several significant patterns concerning the transformation of entrepreneurial ecosystems through artificial intelligence and digital technologies. The strong positive correlation (r = 0.87) between business intelligence adoption and market expansion underscores AI's role as a catalyst for growth rather than merely a supportive tool. This relationship appears particularly pronounced in sustainability-oriented ventures, where data-driven decision-making enables navigation of complex sustainability transitions.

The architectural analysis demonstrates that AI's transformative impact operates through a layered integration model. Digital platforms form the foundational infrastructure, while AI technologies create intelligent capabilities that enable novel business model configurations. This layered structure facilitates what Gregori et al. (2024) term the “enactment of digital connectivity”, where technology becomes an active participant in value creation rather than a passive tool.

The comparative analysis reveals a fundamental divergence between traditional enterprises and AI-native startups. While established firms typically deploy AI to optimize existing operations, startups are constructing entirely new business architectures where artificial intelligence defines the core value proposition. This distinction suggests that the most significant entrepreneurial innovations may emerge from new entrants rather than industry incumbents, though the longitudinal implications require further investigation.

The evolutionary model of organizational capabilities indicates that AI integration follows a progressive trajectory. The transition from assisted to augmented and finally integrated stages represents not merely technological adoption but fundamental organizational transformation. This progression aligns with Zhang et al. (2025) observation of evolving resource actions, where companies progress from basic resource patchwork to sophisticated orchestration capabilities.

The identified barriers to adoption present a complex challenge. Infrastructure limitations and skills deficits constitute the most significant obstacles, suggesting that ecosystem development requires parallel advancement in technological infrastructure and human capital. The resistance index calculation reveals that financial constraints, while substantial, may be secondary to organizational and infrastructural barriers in many contexts.

The scenario analysis indicates that hybrid development paths combining platform economics with regulated AI development represent the most probable future trajectory. This aligns with Stein et al. (2026) emphasis on institutional entrepreneurship, where adaptive regulatory frameworks and new collaboration mechanisms enable ecosystem maturation. The high probability (p = 0.67) of this scenario underscores the importance of balanced approaches that foster innovation while addressing societal concerns.

Several theoretical implications emerge from these findings. The production function analysis challenges traditional economic models by demonstrating AI's distinctive elasticity characteristics. The capability evolution model extends dynamic capability theory by delineating specific maturation stages in digital contexts. The architectural framework contributes to business model innovation literature by illustrating how digital and human actors co-create value in platform-based ecosystems.

Practical implications suggest that entrepreneurs should prioritize developing AI capabilities as strategic assets rather than operational tools. The strong correlation between AI adoption and

performance metrics indicates that early and comprehensive integration may yield competitive advantages. For policymakers, the findings highlight the need for investments in digital infrastructure and skills development alongside regulatory adaptation.

However, several limitations warrant consideration. The analysis primarily draws on successful implementation cases, potentially overlooking failed adoption attempts. Geographical focus on specific regions may limit generalizability across different institutional contexts. The evolving nature of AI technologies means that current findings may require revision as capabilities advance.

Future research should explore the longitudinal evolution of AI-transformed ecosystems, particularly examining how early advantages translate into sustained competitive positioning. Investigation into failure modes and barriers could provide valuable insights for risk mitigation. Comparative studies across diverse geographical and institutional contexts would enhance understanding of contextual factors influencing successful transformation.

The integration of sustainability considerations presents another promising direction. While current research identifies positive correlations, the mechanisms through which AI enables sustainable business model innovation require deeper examination. The relationship between digital transformation and progress toward Sustainable Development Goals merits continued attention as technologies and practices evolve.

In conclusion, the synergy between artificial intelligence and digital technologies is fundamentally reshaping entrepreneurial ecosystems through new business architectures, enhanced capabilities, and novel value creation mechanisms. This transformation represents not merely technological adoption but a fundamental reconfiguration of how entrepreneurial value is created, delivered, and captured in the digital age.

Conclusion

This research demonstrates that the synergy between artificial intelligence and digital technologies is fundamentally restructuring entrepreneurial ecosystems. The transformation extends beyond technological adoption to encompass a complete reconfiguration of value creation mechanisms and business architectures. Artificial intelligence has evolved from a supportive tool to a core strategic element that defines competitive advantage in digital entrepreneurship.

The findings establish that AI-driven entrepreneurial ventures exhibit distinct characteristics compared to traditional business models. These include dynamic value propositions, multi-channel distribution networks, data-driven revenue streams, and predictive customer relationships. The significant correlation between business intelligence adoption and market expansion underscores AI's role as a growth catalyst, particularly in sustainability-oriented ventures.

The architectural analysis reveals that successful ecosystem transformation requires coordinated development across multiple layers. Digital platforms provide the foundational infrastructure, while AI technologies enable intelligent capabilities that support novel business model configurations. The evolutionary progression from AI-assisted to AI-integrated stages represents a fundamental organizational transformation that demands strategic resource orchestration and capability development.

The identification of adoption barriers highlights the critical importance of addressing infrastructure limitations and skills deficits alongside technological implementation. The resistance index reveals that organizational and structural constraints often present greater challenges than financial limitations alone. This underscores the need for comprehensive approaches that combine technological advancement with institutional adaptation.

Future entrepreneurial ecosystem development will likely follow hybrid trajectories that balance platform economics with regulated AI development. The successful integration of artificial intelligence requires collaborative efforts among entrepreneurs, policymakers, educational institutions, and technology providers. Strategic focus should encompass both technological capabilities and the broader institutional frameworks that enable sustainable digital transformation.

The research contributes to theoretical understanding by demonstrating AI's distinctive characteristics in production functions and delineating specific maturation stages in digital contexts.

Practically, it provides guidance for entrepreneurs seeking to leverage AI technologies and policymakers designing supportive ecosystem frameworks. The continued evolution of these synergies will undoubtedly shape the next generation of entrepreneurial innovation and sustainable economic development.

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