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REVIEW

AI-Enabled Entrepreneurship: A Review Based on the Structural Topic Model*

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Abstract

Artificial intelligence (AI) has emerged as a pivotal force in empowering entrepreneurial development, which plays an increasingly important role in its opportunity discovery and creation, resource integration, and value creation. Although attention and research interest in AI within entrepreneurship research have grown substantially, existing studies remain dispersed and lack systematic integration. This study adopts an unsupervised machine-learning approach, Structural Topic Model (STM), which combines automated coding with manual coding, to analyze 122 articles retrieved from the Web of Science. This study maps the current landscape of research on AI-enabled entrepreneurship across its antecedents, contextual settings, processes, outcomes, theoretical lenses, and methodological tools. The analysis reveals six areas requiring further inquiry: (1) deepening the study of motivational mechanisms, (2) enriching research on contextual fields, (3) exploring pathway mechanisms more thoroughly, (4) examining the positive and negative effects of AI empowerment, (5) breaking new ground in underlying theoretical logic, and (6) integrating diverse technological approaches. Building on these insights, it proposes a future research framework and agenda that (1) investigates the motivation of AI-enabled entrepreneurship in the macro, meso, micro, and cross-level scales; (2) conducts multi-contextual studies spanning regions, industries, and domains; (3) analyzes process pathways from cross-level and dynamic perspectives; (4) attends comprehensively to both positive outcomes and potential negatives of AI-enabled entrepreneurship; and (5) develops a distinctive theoretical system grounded in emerging practices, supported by robust data, tools, and methods. By synthesizing the extant literature and outlining this framework, this study offers a reference for enriching and deepening research on AI-enabled entrepreneurship.

Keywords artificial intelligence (AI); machine learning; structural topic model (STM); entrepreneurship

1 Introduction

Currently, artificial intelligence (AI) is spearheading a new wave of scientific and technological revolution and social transformation, profoundly reshaping human production processes,

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lifestyles, and modes of thought, and exerting significant and far-reaching effects on economic development, social progress, and corporate growth. In December 2022, OpenAI introduced the generative AI model—Chat Generative Pre-trained Transformer (ChatGPT), which immediately attracted widespread attention. Within just two months, it reached over 100 million active users, making it the fastest-growing consumer application in history.

The Chinese government attaches great importance to the development of AI. Between 2017 and 2022, the Government Work Reports repeatedly referred to AI, initially framing it as "developing AI technologies," "intelligent manufacturing," and "enhancing the level of intelligence," and later shifting to "further fostering and expanding digital industries such as AI," which reflects the government's sustained attention to the advancement of AI and ongoing efforts to promote the development and deployment of AI. According to the Hurun Global Unicorn List 2023, as of December 31, 2022, China hosts 316 unicorn enterprises, second only to the US, with AI-related unicorn enterprises accounting for over 90%. AI has become a key strategic tool for invigorating entrepreneurial vitality, securing a leading position in the global wave of AI technology, and advancing Chinese modernization.

AI refers to the intelligence exhibited by machines, which can learn from external data, adapt, and perform tasks associated with human intelligence (Obschonka & Audretsch, 2020; Shepherd & Majchrzak, 2022). AI permeates various technical domains such as machine learning and deep learning (Shepherd & Majchrzak, 2022) and application scenarios, including Industry 4.0, smart cities, and robotics (Chalmers et al., 2021; Obschonka & Audretsch, 2020). Driven by the recent surge in big data, advances in algorithms, and improvements in computing power, research on AI in organizational management, marketing, economics, and innovation is flourishing, and studies on AI and entrepreneurship are beginning to attract scholarly attention. In 2020, the journal *Small Business Economics* launched a special issue on the new possibilities for research design and methodology in terms of entrepreneurship in the contexts of AI and big data (Kaminski & Hopp, 2020; Liebregts et al., 2020; Obschonka & Audretsch, 2020; Obschonka et al., 2020; Zhang & van Burg, 2020). In 2022, *Entrepreneurship Theory and Practice*, a leading journal in entrepreneurship, published dedicated articles on the integration mechanisms of AI and entrepreneurial activities in an Industry 4.0 context (Chalmers et al., 2021) and the importance and feasibility of AI-enabled entrepreneurship research (Lévesque et al., 2022). *Journal of Business Venturing* explored how machine learning, as a "super tool," can advance research on entrepreneurship (Shepherd & Majchrzak, 2022).

AI can function both as a technology that empowers entrepreneurial practices and as a methodological tool that enriches research on entrepreneurship, resulting in marked differences in topics and approaches across the literature. Accordingly, we classify existing studies into two types based on whether they apply AI technologies. To date, research on AI-enabled entrepreneurship remains nascent: Theoretical foundations and research perspectives are fragmented, and disciplinary divides between entrepreneurship and AI have hindered comprehensive synthesis. There is, therefore, a pressing need for systematic and scientifically grounded reviews of current progress. This study employs an unsupervised machine learning approach, Structural Topic Model (STM), in concert with automated and manual coding to build a framework for research on AI-enabled entrepreneurship. The framework is organized around the antecedents, contexts, processes, and other dimensions of AI-enabled entrepreneurship, with the aim of better guiding future inquiry.

2 Research Design

2.1 Literature Screening

This study draws on publications from the Science Citation Index (SCI) and the Social Science Citation Index (SSCI) (indexed journals in the Web of Science database) over the period 1991–2022, following an "identification–screening–eligibility–inclusion" protocol. We searched the title, abstract, and keyword fields for entrepreneurship-related terms ("entrepreneur*," "new venture*," "emerging venture*," "founder*," "start-up*," "spin-off*," "SMEs") and AI-related terms ("artificial intelligence," "machine learning," "deep learning," "smart," "robot") (Liu & Wang, 2020; Ma et al., 2025), yielding 1,584 articles. Although *Journal of Business Venturing Insights* is not SSCI-indexed, we included it due to its close affiliation with *Journal of Business Venturing* and its strong practical orientation. Through multiple rounds of paired screening and backward citation searching, we ultimately retained 122 relevant articles (see Figures 1 and 2).

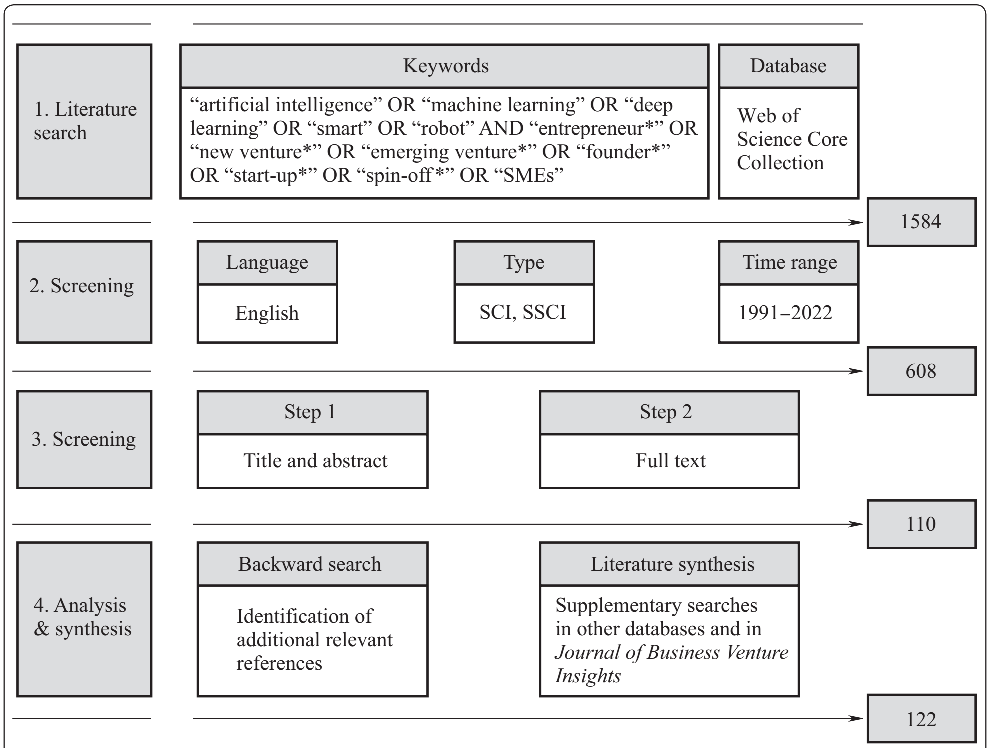


Figure 1 Literature Screening Process

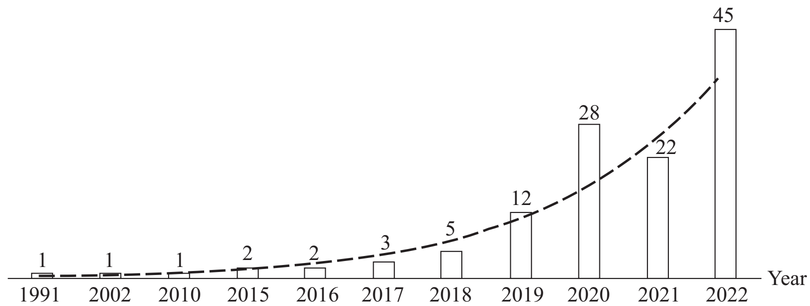


Figure 2 Number of Publications on AI-Enabled Entrepreneurship, 1991–2022

2.2 Structural Topic Model

2.2.1 Structural Topic Model as an Extension of Topic Model

Topic Model, particularly Latent Dirichlet Allocation (LDA), is an unsupervised machine-learning algorithm that automatically uncovers latent themes in a corpus without manual annotation. LDA assumes that each document arises from a mixture of topics, and a word distribution characterizes each topic. Through Bayesian inference, LDA infers both the topic distribution for each document and the word distribution for each topic, thereby revealing the thematic structure of the document set. LDA offers several advantages, including efficient dimensionality reduction, extraction of coherent and interpretable topics, and the ability to overcome limitations of traditional text-analysis methods (Ma et al., 2025; Roberts et al., 2013). However, LDA's assumption of topic independence can hinder its ability to capture variations in topics and word usage across documents. To address these shortcomings, researchers have proposed various extensions, notably STM, developed by Roberts et al. (2013). STM enhances LDA by incorporating document-level covariates, such as author, publication time, and affiliation, thus allowing more accurate estimation of topic prevalence and word distributions. Accordingly, this study employs STM for literature analysis (Roberts et al., 2013).

2.2.2 Data Preprocessing

A critical aspect of STM is the choice of covariates. A review of the literature on AI and entrepreneurship reveals that AI empowers both entrepreneurial practice and research on entrepreneurship, yielding two distinct streams with markedly different themes and content. Consequently, we include "use of AI" as a covariate in our STM analysis. To maximize model effectiveness and accuracy, we analyze full-text articles so as to comprehensively reflect the field's research landscape and obtain well-trained topics. Preprocessing steps involve removing nontext elements (e.g., tables, acknowledgments, and references), eliminating stopwords (including search terms), performing case normalization and lemmatization, and excluding words that occur fewer than five times in the corpus to reduce low-frequency noise (Choi et al., 2021; Ma et al., 2025). All analyses are implemented in R.

2.2.3 Topic Model

Figure 3 presents semantic coherence and exclusivity across different numbers of topics. Semantic coherence gauges the internal consistency of a topic, and higher values indicate stronger internal consistency and, consequently, better model performance, while exclusivity assesses how distinct each topic is from the others, with higher values reflecting less overlap and clearer separation. As shown in Figure 3, semantic coherence increases and then decreases around nine topics, whereas exclusivity decreases before rising. Based on these diagnostics and substantive interpretability (Choi et al., 2021), nine topics were chosen as the optimal solution.

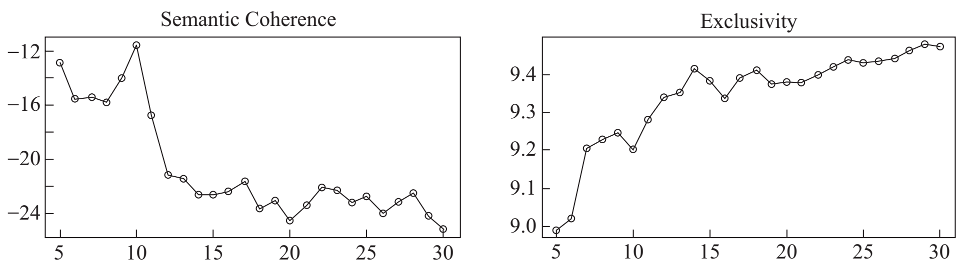


Figure 3 Parameter Changes across Different Topic Counts in the Structural Topic Model

Table 1 shows the manually coded themes derived from the STM-generated topic keywords. Topics 4 and 7, which focus on identifying the characteristics of AI entrepreneurs and new entrepreneurial opportunities in the digital intelligence era, are classified as the theme of "antecedent"; Topics 1, 5, and 9, which address online platforms, smart cities, and regional/rural contexts, constitute the theme of "context"; Topics 2 and 3 pertain to AI-enabled entrepreneurial financing and resource integration and form the theme of "process"; and Topics 6 and 8, which are related to enabling the growth of new ventures and predicting the outcome, are grouped as the theme of "outcome." The use of AI exerts a clear effect on topic prevalence: Topics 3, 5, 6, and 7 predominantly discuss AI applications in entrepreneurship via traditional research methods, whereas Topics 1, 4, 8, and 9 conduct entrepreneurship research based on AI technology. For Topics 2 and 9, some studies employ traditional methods, while others utilize AI technologies. Detailed distributions of these topics are presented in Figure 4.

Table 1 Results of Theme Clustering

Theme (secondary code)	Topic No.	Topic	Keywords
Antecedent	4	AI technology and entrepreneurs	emot, affect, facial, social, psycholog, behavior, express, categori, ceo, person, posit, individu
	7	Digital intelligence era and entrepreneurial opportunities	data, busi, new, model, technolog, opportun, servic, develop, provid, system, process, creat

(*To be continued*)

(*Continued*)

Theme (secondary code)	Topic No.	Topic	Keywords
Context	1	Contexts of Crowdfunding entrepreneurship	crowdfund, project, fund, inform, social, success, invest, descript, text, model, onlin, word
	5	Contexts of smart cities	citi, develop, social, innov, technolog, new, urban, data, project, local, industri, univers
	9	Other contexts of entrepreneurship	rural, treatment, hire, job, incom, region, embedded, skill, estim, big, twitter, extern
Process	2	Entrepreneurial financing and value assessment	invest, decis, human, algorithm, design, data, process, make, tool, provid, busi, predict
	3	Business model and resource integration	technolog, innov, busi, data, develop, resourc, process, capabl, opportun, new, system, product
Outcome	6	Venture growth and innovation	industri, digit, compani, technolog, busi, product, innov, model, market, new, social, develop
	8	AI-enabled entrepreneurship prediction	surviv, valuat, startup, predict, causal, bankruptci, tree, failur, round, score, accuraci, profit

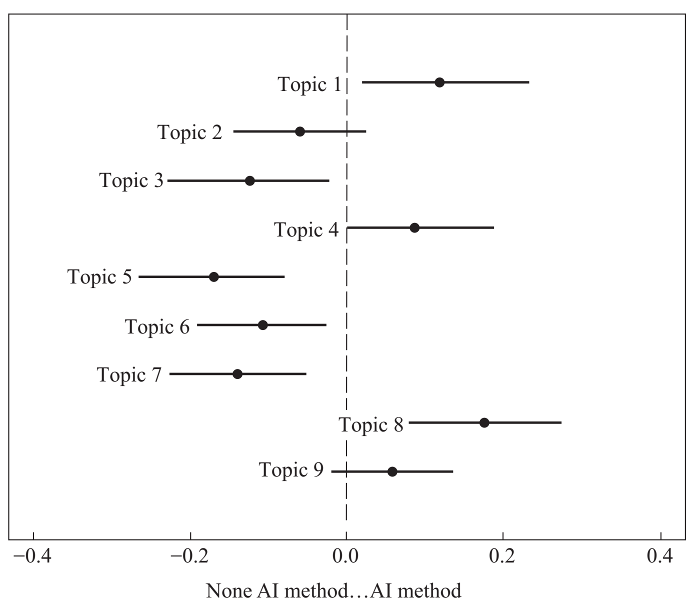


Figure 4 Topic Prevalence by the Covariate "Use of AI Methods"

3 Review of AI-Enabled Entrepreneurship Research

3.1 Antecedents of Entrepreneurship

First, using theoretical analysis, case studies, and structural equation modeling, scholars emphasize AI's role in identifying and exploiting entrepreneurial opportunities, drawing on theoretical lenses such as effectual design logic and causal logic; these studies align with Topic 7, "Digital intelligence era and entrepreneurial opportunities." Second, researchers apply AI algorithms, most notably artificial neural networks, to investigate the characteristics and behaviors of entrepreneurs from the perspectives of signaling theory and emotional contagion theory; these findings correspond to Topic 4, "AI technology and entrepreneurs." Details are presented in Figure 5.

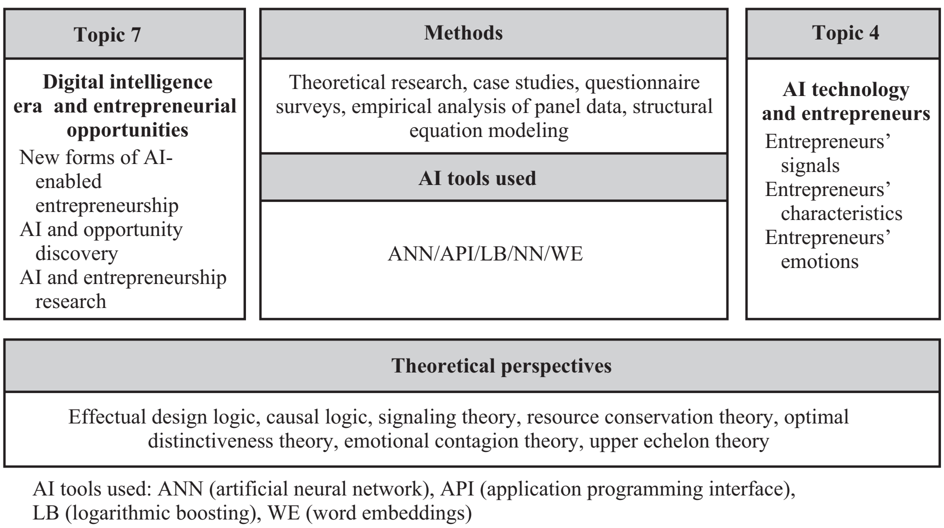


Figure 5 Antecedents Research Framework of AI-Enabled Entrepreneurship

3.1.1 Digital Intelligence Era and Entrepreneurial Opportunities

AI introduces new business models for entrepreneurship. New ventures can use AI technologies to collect and analyze data in real time through smart devices, thus enabling them to identify and create novel market opportunities (Garbuio & Lin, 2019). Moreover, AI drives new business development by enabling smart contracts that optimize transaction processes and reduce entrepreneurs' opportunism and moral hazard (Meier & Sannajust, 2021).

AI facilitates the discovery of entrepreneurial opportunities. AI overcomes humans' limitations in information processing by mining latent patterns and details from vast datasets, thus empowering entrepreneurs to identify and develop new opportunities (Chalmers et al., 2021). For example, AI integrates fragmented information to furnish entrepreneurs with deep market insights, thereby uncovering opportunities in product development and customer discovery (Ge et al., 2022; Shepherd & Majchrzak, 2022). Moreover, AI technologies enable entrepreneurs to discern opportunities arising from technological change and support business model optimization and process improvement in new ventures (Chalmers et al., 2021).

AI significantly influences theory development, data collection, and result interpretation in entrepreneurship research (Shepherd & Majchrzak, 2022). By facilitating interdisciplinary knowledge integration, AI unlocks the potential of data and offers solutions for nonlinear and unstructured complex problems (Zhang & van Burg, 2020). Furthermore, the judicious application of AI aids in testing established entrepreneurial theories and constructing new theoretical frameworks, thereby enhancing the rigor of research findings (Lévesque et al., 2022).

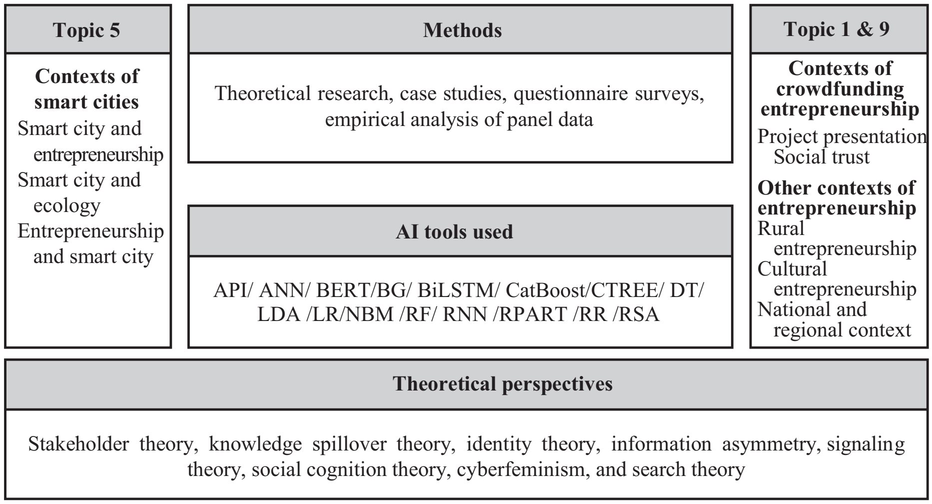
3.1.2 AI Technology and Entrepreneurs

Existing studies employ algorithmic classification and prediction methods alongside empirical approaches to examine how entrepreneurs influence venture activities. Research shows that entrepreneurs' signaling plays a crucial role in evaluating the risks of entrepreneurship (Duan et al., 2020); for example, masculine traits lead entrepreneurs to prioritize potential returns while underestimating risks (Gong et al., 2020). Among female entrepreneurs, the presence of masculine characteristics exhibits an inverted-U relationship with entrepreneurial financing outcomes, indicating that female entrepreneurs remain subject to male-dominated norms (Wang et al., 2023).

In examining the interface between entrepreneurs' emotions and their entrepreneurial behaviors, recent research uses AI algorithms, such as artificial neural networks, to detect emotional constructs like entrepreneurial passion and depression. Findings indicate that founders' signals of inclusiveness and passion increase the probability of successful entrepreneurial financing (Kaminski & Hopp, 2020), while entrepreneurial passion wanes over time, underscoring the need for prompt feedback and support for entrepreneurs (Williamson, Battisti, & Pollack, 2022). Entrepreneurs with a strong internal attributional style are more susceptible to disappointment when facing unanticipated setbacks, which can precipitate entrepreneurial depression (Williamson, Drencheva, & Battisti, 2022). Conversely, a near-miss experience enables entrepreneurs to move beyond the shadow of failure and re-engage in entrepreneurial endeavors (Fan-Osuala, 2021).

3.2 Contexts of Entrepreneurship

Studies in this theme first examine the context of smart cities (Topic 5) through theoretical lenses such as stakeholder theory and ecosystem theory. Second, drawing on knowledge spillover theory and signaling theory, researchers apply AI algorithms, most notably decision trees, to analyze crowdfunding entrepreneurship (Topic 1) and a variety of other contexts, including rural and regional entrepreneurship (Topic 9). Details are presented in Figure 6.



AI tools used: API (application programming interface), ANN (artificial neural network), BERT (bidirectional encoder representations from transformers), BG (bagging), BiLSTM (bidirectional long short-term memory), CatBoost (categorical boosting), CTREE (conditional inference tree), DT (decision tree), LDA (latent Dirichlet allocation), LR (logistic regression), NBM (Naïve Bayes model), RR (ridge regression), RF (random forest), RSA (rough set analysis), RNN (recurrent neural network), RPART (recursive partitioning and regression trees), and LASSO (least absolute shrinkage and selection operator)

Figure 6 Framework of Related Research on Contexts of AI-Enabled Entrepreneurship

3.2.1 Contexts of Smart Cities

Smart cities integrate diverse technological applications, such as digital infrastructure deployment (Barba-Sánchez et al., 2019), operational data analytics (Kummitha, 2019), shared vision building (Kraus et al., 2015), and solution development, to spur entrepreneurial activities. In this ecosystem, multiple stakeholders, including universities and government agencies, play pivotal roles. Universities use social networks to coordinate stakeholders and consolidate key information, thereby driving the generation and commercialization of AI-related knowledge (Doloreux & Turkina, 2021; Ferraris et al., 2020). Entrepreneurs, through AI-based ventures, facilitate urban technological transformation, feed back into the construction of smart cities, foster the development of AI entrepreneurship clusters, and attract multinational capital to further enrich the local entrepreneurial ecosystem (Doloreux & Turkina, 2021).

3.2.2 Contexts of Crowdfunding Entrepreneurship

In the digital economy era, crowdfunding has become an increasingly important channel for entrepreneurs to obtain necessary capital and pursue new ventures (Gong et al., 2020). By using AI to analyze hidden cues in other entrepreneurs' gestures, facial expressions, and speech-to-text data, entrepreneurs can mitigate information asymmetry and enhance the success of crowdfunding campaigns (Kaminski & Hopp, 2020).

Telling a compelling story of entrepreneurship is key to successful crowdfunding. By appropriately prioritizing both subjective and objective elements, such as theme, branding, business model, and rewards, and avoiding information distortion or misrepresentation, entrepreneurs can more effectively convey their story, engage audiences, and drive successful outcomes (Wang et al., 2021; Wang et al., 2022). Moreover, disruptive ventures, which transcend traditional entrepreneurial paradigms, demand the communication of clearer and more reliable information to ensure smooth project execution (Jung et al., 2022).

Crowdfunding projects often suffer from high information asymmetry; therefore, entrepreneurs' demonstrated trustworthiness can alleviate investors' concerns about moral hazard in crowdfunding campaigns (Gong et al., 2020). Moreover, entrepreneurs can tailor their approaches to match investors' profiles to boost crowdfunding success. For example, investors with a strong sense of identity favor ventures that enhance their personal influence, whereas those with a weaker sense of identity place greater emphasis on a project's sustainability and social impact (Toschi et al., 2023).

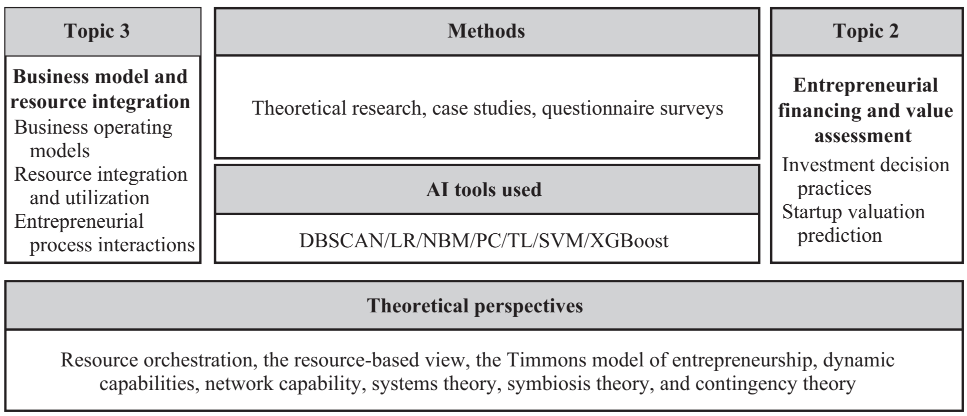
3.2.3 Other Contexts of Entrepreneurship

Scholars have employed methods such as rough set analysis and random forest algorithms to examine the contexts of rural entrepreneurship, ethnic entrepreneurship, and cultural entrepreneurship. They find that capability heterogeneity among rural entrepreneurs leads to substantial disparities in entrepreneurial performance (Carter et al., 2019), while access to business and technical knowledge, market insights, social networks, and venture capital are critical enablers for disadvantaged entrepreneurs (Masurel et al., 2002). In cross-category, differentiated cultural entrepreneurship, centering the venture narrative on established cultural concepts leads to greater success. When focusing on a limited number of categories, leveraging cultural connotations to enrich the narrative can further secure entrepreneurial support (Vossen & Ihl, 2020).

Scholars using AI technologies have uncovered intriguing entrepreneurship patterns at the regional and national levels. A study employing ridge regression to model regional Big Five personality traits finds that extraversion, conscientiousness, and openness positively correlate with entrepreneurial rates; agreeableness is negatively correlated, and neuroticism shows no significant relationship with them (Obschonka et al., 2020). Other research, using LDA to analyze regional ecosystems of AI-enabled entrepreneurship, indicates that regional cultural insights facilitate the formation of these ecosystems as well as the discovery of entrepreneurial opportunities (Hannigan et al., 2022). National institutional environments also shape entrepreneurial behavior: Countries with stable economic governance, high-quality healthcare and education, abundant social capital, and safe environments better support entrepreneurs in pursuing opportunities (Jabeur et al., 2022). Moreover, a nation's sustainability orientation influences entrepreneurs' moral hazard aversion, resulting in variations in entrepreneurial forms (Butticè et al., 2019).

3.3 Processes of Entrepreneurship

Scholars investigate business model innovation and resource integration in the AI-enabled entrepreneurial process (Topic 3) through theoretical lenses such as resource orchestration, the Timmons model of entrepreneurship, and dynamic capabilities. In addition, related studies apply algorithms, such as Naïve Bayes and transfer learning, to examine entrepreneurial financing and valuation (Topic 2). See Figure 7 for details.



AI tools used: DBSCAN (density-based clustering of applications with noise), LR (logistic regression), NBM (the Naïve Bayes model), SVM (support vector machines), XGBoost (extreme gradient boosting), TL (transfer learning), and PC (Peter-Clark)

Figure 7 Framework of Related Research on Processes of AI-Enabled Entrepreneurship

3.3.1 Business Model and Resource Integration

AI introduces greater complexity and uncertainty into the entrepreneurial process, makes the interplay among the three core elements, opportunities, resources, and teams more dynamic, and drives profound changes in business models, resource integration, and entrepreneurial interactions.

AI transforms new ventures' business models by enabling the development of novel opportunities, the formulation of agile startup strategies, and interaction with intelligent machines (Obschonka & Audretsch, 2020). It also drives the cyclical iteration and updating of entrepreneurial products, facilitates component deconstruction, validation, matching, and commercialization, and fosters a deep integration of traditional business models with digital technologies (Li et al., 2022).

AI facilitates resource integration in new ventures. New ventures leverage AI-enabled market analysis to strengthen partnerships and enhance their resource allocation capabilities throughout the entrepreneurial process (Ge & Zhao, 2022). By using AI to analyze and predict consumers' social media engagement, new ventures can dynamically build social networks, flexibly adjust marketing strategies, and align resources with their strategic objectives (Jung & Jeong, 2020).

AI drives interactive dynamics among the entrepreneurial ecosystems. Enterprises can use AI to share resources, whereby a virtuous cycle is formed within the entrepreneurial ecosystem. AI not only fosters strong connections among entrepreneurs but also promotes interaction with institutional environments through AI application scenarios, thereby driving institutional entrepreneurship (Doloreux & Turkina, 2021).

3.3.2 Entrepreneurial Financing and Value Assessment

Related studies primarily use AI to explore financing and value assessment in the entrepreneurial process. In venture funding, AI provides powerful tools that prompt venture capital enterprises to reassess traditional "spray and pray" investment approaches (Blohm et al., 2022). By intelligently analyzing vast information and precisely identifying relevant signals, AI empowers entrepreneurs and investors in their financing decisions and investment behaviors. Through risk-return analyses, AI recommends forward-looking financing channels and investment platforms to entrepreneurs (Bertoni et al., 2022) and enables higher portfolio returns under budget constraints (Blohm et al., 2022).

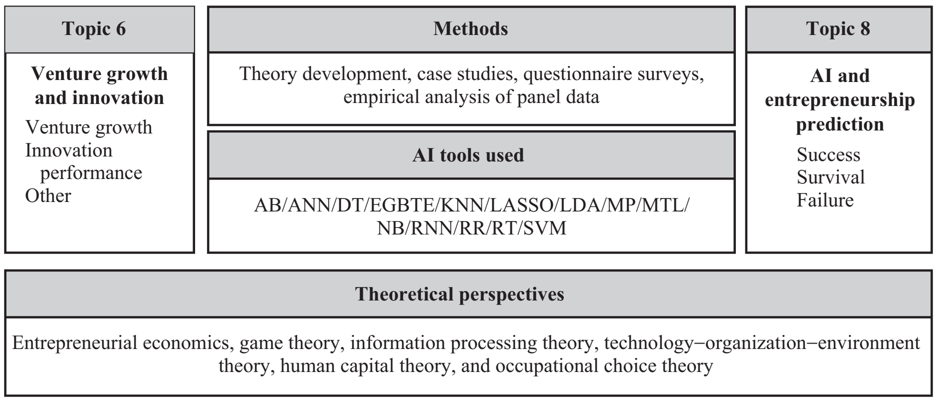
In terms of venture valuation, studies employing algorithms such as gradient boosting have identified key factors influencing startup valuation, including financial capital, human capital, market environment, and regulatory compliance (Garkavenko et al., 2023), and have examined the effects of founders' experience, team size, funding amount, and media visibility (Taboga, 2022).

3.4 Outcomes of Entrepreneurship

Studies in Topic 6 examine the effects of AI on new-venture growth (Baabdullah et al., 2021; Ballestar et al., 2020) and innovation (Somohano-Rodríguez et al., 2022) from theoretical perspectives such as information processing theory and the technology-organization-environment framework. Moreover, under Topic 8, researchers using large-scale entrepreneurship datasets apply AI technologies, such as artificial neural networks, decision trees, and ridge regression, to predict outcomes like venture success and survival (Graham & Bonner, 2022; Koumbarakis & Volery, 2023). See Figure 8 for details.

3.4.1 Venture Growth and Innovation

Relevant studies examine the effects of AI on entrepreneurial outcomes in the context of Industry 4.0, including the performance, growth, and innovation of new ventures. Intelligent robots enhance productivity, stimulate knowledge value creation, and boost both sales and export volumes in new ventures (Ballestar et al., 2020). AI enables startups to offer highly customized service experiences by rapidly adjusting marketing strategies to meet customer needs, strengthening partnerships, and driving the growth of startups (Baabdullah et al., 2021). Moreover, technologies such as big data analytics and robotics further empower small and medium-sized enterprises (SMEs) to innovate and optimize operational and product development processes, thereby fostering exploratory business model innovation (Somohano-Rodríguez et al., 2022).



AI tools used: AB (adaptive boosting), ANN (artificial neural network), DT (decision tree), EGBTE (extreme gradient boosting tree ensemble), KNN (K-nearest neighbors), LASSO (least absolute shrinkage and selection operator), LDA (latent Dirichlet allocation), MP (multilayer perceptron), MTL (multi-task learning), NB (naive Bayes), RNN (recurrent neural network), RR (ridge regression), RT (random forest), SVM (support vector machines)

Figure 8 Framework of Related Research on Outcomes of AI-Enabled Entrepreneurship

3.4.2 AI-Enabled Entrepreneurship Prediction

As AI technologies evolve, scholars increasingly draw on large datasets and AI models to analyze the factors driving the success and failure of new ventures. Graham and Bonner (2022) apply decision tree algorithms to a dataset from the Global Entrepreneurship Monitor and find that venture initiation is chiefly driven by entrepreneurial self-efficacy, social networks, and opportunity recognition, with cultural influences playing a comparatively minor role. Koumbarakis and Volery (2022) use support vector machines on a dataset from the Panel Study of Entrepreneurial Dynamics (PSED) research program to show that smooth venture progression is associated with factors such as founders' experience, capital investment, initial sales, and industry sector. Camacho-Miñano et al. (2015) employ decision trees on financial datasets and demonstrate that total assets, return on assets, and the number of shareholders are key predictors of the bankruptcy of SMEs during crises.

4 Theoretical Perspectives and Methodological Tools in AI-Enabled Entrepreneurship Research

Given that AI-enabled entrepreneurship studies seldom include keywords explicitly denoting their theoretical lenses or methodological tools, the topics generated by STM do not directly reveal these dimensions. Consequently, we conduct a manual review and coding of the relevant literature to synthesize the theoretical perspectives and methodological approaches employed in this body of research.

4.1 Theoretical Perspectives in AI-Enabled Entrepreneurship Research

As evidenced by the foregoing review, existing studies on AI-enabled entrepreneurship comprise a myriad of complex themes that draw upon multiple theoretical perspectives. In terms of their theoretical traditions, these can be grouped into entrepreneurship-specific theories, economic theories, psychological theories, and management theories (see Table 2).

Table 2 Theoretical Perspectives in AI-Enabled Entrepreneurship Research

Theoretical tradition	Theory	Occurrences	Representative view
Entrepreneurship-specific theories	Effectual design logic	3	Effectual design logic can derive new insights from genetic algorithms (Zhang & van Burg, 2020).
	Timmons model of entrepreneurship	1	AI reshapes the three entrepreneurial elements: opportunities, resources, and teams (Li et al., 2022).
Economic theories	Information asymmetry	4	AI reduces information asymmetry and moral hazard in the entrepreneurial process (Gong et al., 2020; Meier & Sannajust, 2021).
	Signaling theory	1	Using AI technologies to analyze entrepreneurs' signals (Liebregts et al., 2020).
	Knowledge spillover theory	2	Smart city initiatives generate regional knowledge spillovers (Barba-Sánchez et al., 2019).
Psychological theories	Identity theory	1	Using AI to identify entrepreneurs' and investors' identities (Toschi et al., 2023).
	Big Five personality theory	2	Using AI to analyze Big Five traits at both the individual and regional levels to empower entrepreneurship research (Obschonka et al., 2020).
Management theories	Optimal distinctiveness theory	1	An identity of legitimate distinctiveness confers entrepreneurial advantage (Vossen & Ihl, 2020).
	Dynamic capabilities	1	AI facilitates integration of information and financial flows and enhances dynamic capabilities (Ge & Zhao, 2022).
	Stakeholder theory	1	AI identifies stakeholders in the entrepreneurial ecosystem and maps their network ties (Hannigan et al., 2022).

Entrepreneurship-specific theories. Entrepreneurship-specific theories cover foundational models in the field, such as effectual design logic and the Timmons model of entrepreneurship. Zhang and van Burg (2020) argue that entrepreneurship research can glean new insights into effectual design logic from genetic algorithms, thereby fostering the further development of entrepreneurship. Li et al. (2022), drawing on Timmons' triadic framework of opportunities, resources, and teams, propose that AI can both reshape existing opportunity foundations and create novel opportunities through data-driven learning and pattern extraction.

Economic theories. Theoretical perspectives drawn from economics encompass information asymmetry, signaling theory, and knowledge spillover theory. AI can detect latent fraud in contracts (Meier & Sannajust, 2021) and assess entrepreneurs' facial trustworthiness (Gong et al., 2020), thereby reducing information asymmetry and moral hazard in the entrepreneurial process. Liebregts et al. (2020), drawing on signaling theory, argue that AI-driven analysis of signals emitted by entrepreneurs can deepen our understanding of entrepreneurial decision-making. Barba-Sánchez et al. (2019), from the perspective of knowledge spillovers, contend that smart cities confer knowledge advantages for developing new skills and that these spillovers, in turn, drive the growth of new ventures.

Psychological theories. Theoretical perspectives drawn from psychology primarily include identity theory and Big Five personality theory, with a focus on founders and investors. Investors' identities influence the entrepreneurial financing process, and entrepreneurs should seek investors whose styles match their own to improve the success of entrepreneurship (Toschi et al., 2023). In addition, regional environments characterized by extraversion, conscientiousness, and openness are more likely to foster entrepreneurial vitality (Obschonka et al., 2020).

Management theories. These encompass theories such as optimal distinctiveness theory, dynamic capabilities, and stakeholder theory. Vossen and Ihl (2020) argue that entrepreneurs must achieve optimal distinctiveness and maintain an organizational identity of legitimate distinctiveness to secure entrepreneurial advantage. Ge and Zhao (2022) observe that AI technologies facilitate the integration of information and financial flows, pave the way for technological innovation and strategic goal fulfillment in new ventures, and ultimately enhance dynamic capabilities. From the perspective of stakeholder theory, research shows that AI identifies stakeholders and their network ties more effectively (Hannigan et al., 2022), thereby fostering a virtuous cycle within the entrepreneurial ecosystem.

4.2 Methodologies in AI-Enabled Entrepreneurship Research

Traditional methodologies, such as theoretical analysis, qualitative inquiry, and empirical methods (e.g., questionnaire surveys), remain predominant. Scholars have conducted theoretical investigations into the effects of AI on entrepreneurship, including AI's role in entrepreneurial processes under Industry 4.0 (Chalmers et al., 2021) and the big-data era (Obschonka & Audretsch, 2020), the empowerment of entrepreneurship through machine learning (Shepherd & Majchrzak, 2022), and the feasibility of applying AI in entrepreneurship research (Lévesque et al., 2022). In addition, qualitative studies have explored how smart city initiatives influence entrepreneurial activity (Doloreux & Turkina, 2021; Ferraris et al., 2020; Kummitha, 2019), and empirical research has investigated the relationship between AI technologies, such as intelligent robotics, and the performance of SMEs (Ballestar et al., 2020).

Machine learning-based AI technologies are invigorating entrepreneurship research. Researchers use large-scale datasets (Graham & Bonner, 2022; Koumbarakis & Volery, 2023) and apply methods such as natural language processing and deep learning to examine entrepreneurial phenomena. These approaches are employed not only to classify entrepreneurial activities (Butticè et al., 2019) but also to predict the success of financing (Bertoni et al., 2022), start up's valuation (Garkavenko et al., 2023), and bankruptcy (Camacho-Miñano et al., 2015).

Some studies adopt a mixed-methods approach, following traditional paradigms for theory development and hypothesis testing, while using AI technologies, such as machine learning and natural language processing, in variable construction or empirical analysis (see Figure 9). For example, they construct measures of entrepreneurs' facial trustworthiness (Gong et al., 2020), network identity (Wang et al., 2023), green entrepreneurship (Butticè et al., 2019), and cultural entrepreneurship categories (Vossen & Ihl, 2020).

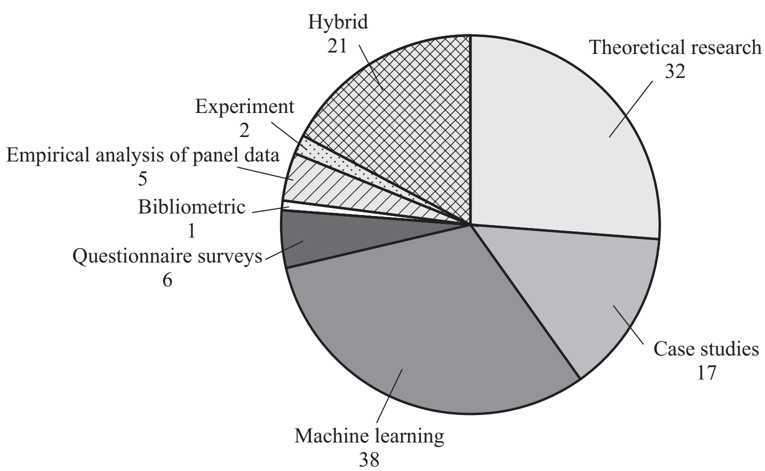


Figure 9 Methodological Tools in AI-Enabled Entrepreneurship Research

5 Main Findings and Future Directions

AI is profoundly affecting the field of entrepreneurship and offering new opportunities for both research and practice. By integrating STM with manual coding, this study maps the current landscape of AI-enabled entrepreneurship research. We find that, although considerable progress has been made in recent years, this emerging domain still harbors numerous topics requiring deeper investigation. Accordingly, we propose future research directions across six dimensions, including the antecedents, contexts, processes, outcomes, theoretical perspectives, and methodological tools of AI-enabled entrepreneurship, which are summarized in Figure 10.

(1) In terms of the antecedents of AI-enabled entrepreneurship, research on the motivational mechanisms driving AI-enabled entrepreneurship remains underdeveloped, and future studies should deepen analysis across macro, meso, micro, and cross-level scales. At the macro level, scant attention has been paid to government policies, particularly AI-related regulation, and their roles in fostering entrepreneurial activity, while most technological research focuses on individual AI technologies without considering entrepreneurs' cognitive processes. Building on AI development practices, scholars should: systematically review AI policies to clarify governmental functions in AI-enabled entrepreneurship; examine AI-enabled entrepreneurship from the perspective of multi-technology integration, including how emerging innovations like the metaverse and generative AI empower entrepreneurship; investigate organizational factors by exploring the interplay between emerging AI technologies and established organizational structures; and explore how entrepreneurs' mindset traits (e.g., overconfidence and passion) interact with algorithmic rationality (Shepherd & Majchrzak, 2022). These efforts will advance cross-level, multi-factor, and dynamic investigations into AI-enabled entrepreneurship.

(2) From a contextual standpoint, research on the situational domains of AI-enabled entrepreneurship remains underdeveloped, and future studies should pursue multi-context investigations spanning regions, industries, and domains. The current literature gives insufficient attention to cross-sector entrepreneurship, ventures in underdeveloped regions, entrepreneurship among marginalized groups, academic entrepreneurship, and ecosystem dynamics, and it lacks the robust data foundations needed for deeper empirical analysis. Building on the application scenarios of AI, scholars should examine how regional contexts and ecosystem conditions shape AI-enabled entrepreneurship, deepen investigations into contexts such as rural, academic, and social entrepreneurship (Lévesque et al., 2022), and strengthen the data infrastructure underpinning these diverse settings. Exploring the construction of entrepreneurial ecosystems across different domains will yield fresh insights to comprehensively guide both research and practice in AI-enabled entrepreneurship (Chalmers et al., 2021).

(3) From a process perspective, the mechanisms by which AI empowers entrepreneurship remain underexplored, and future research must adopt cross-level, dynamic approaches. Existing studies typically analyze the relationships between AI and entrepreneurship from isolated, linear viewpoints, while overlooking the fact that AI-enabled entrepreneurship evolves through open, nonlinear, iterative processes (Chalmers et al., 2021; Lévesque et al., 2022). Empirical investigations into the dynamic pathways and underlying mechanisms of AI-enabled entrepreneurship are scarce. Looking forward, researchers should use AI's capacity to capture rich entrepreneurial data (Lévesque et al., 2022): By automatically

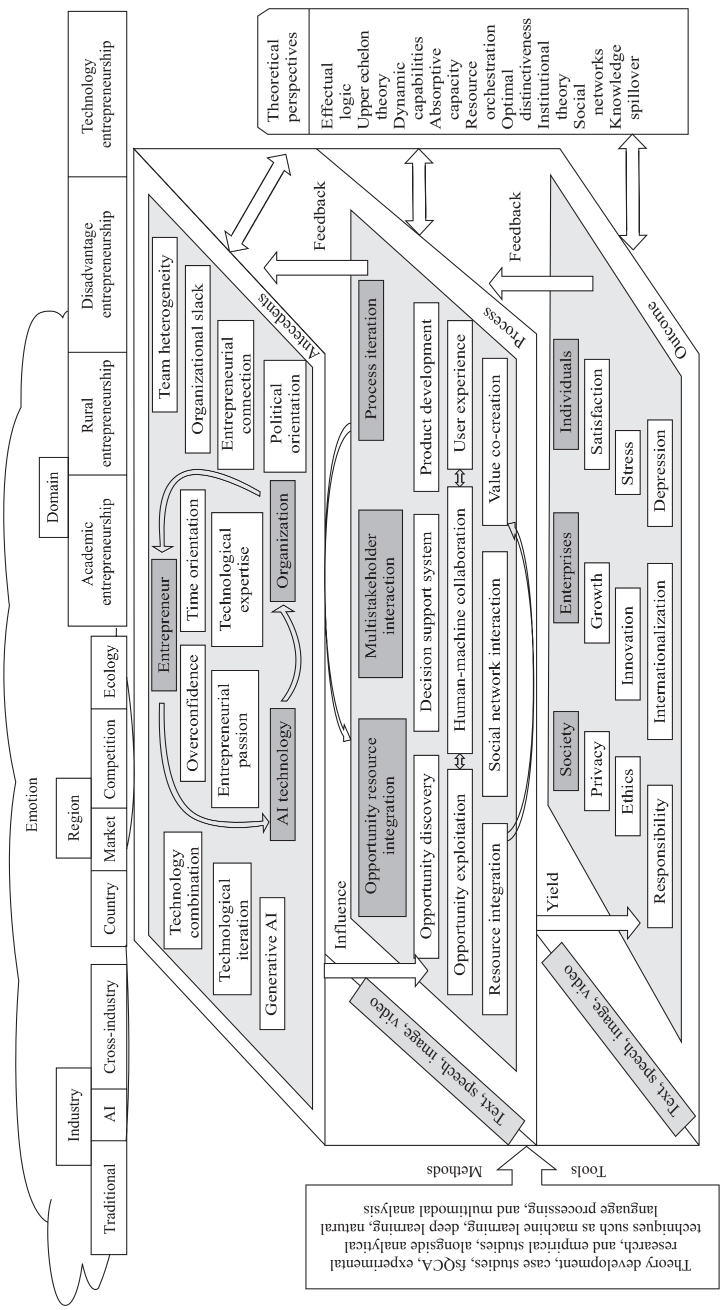


Figure 10 Framework of AI-Enabled Entrepreneurship Research

tracking enterprises over time, future study can trace how resource integration and value co-creation unfold across different stages of entrepreneurship; by analyzing activity data at the individual, industry, and national levels, future study can disentangle the multi-layered, complex processes through which AI empowers entrepreneurship. Finally, AI can be used to extract, analyze, and integrate environmental factors into composite decision evaluation frameworks, enabling intelligent decision support systems under uncertainty and offering practical guidance for entrepreneurial decision making (Chalmers et al., 2021; Shepherd & Majchrzak, 2022).

(4) From the perspective of outcomes, research on the positive and negative effects of AI-enabled entrepreneurship remains underdeveloped, and future studies should address both its positive and negative effects comprehensively. To date, the literature has predominantly examined its beneficial outcomes, such as enhanced performance and innovation, while neglecting potential social responsibility issues like algorithmic accountability, ethical concerns, and data privacy. Future work must balance the economic and social value of AI-enabled entrepreneurship by not only assessing its positive contributions but also scrutinizing adverse effects and corporate responsibility, including algorithmic accountability, data-privacy risks, and energy consumption (Chalmers et al., 2021).

(5) From a theoretical standpoint, the foundational logic of AI-enabled entrepreneurship remains underdeveloped, and future research must strive to construct a distinctive theoretical framework grounded in emerging practices. Most existing studies continue to rely on established theoretical paradigms, drawn primarily from economics (Gong et al., 2020; Kummitha, 2019; Liebregts et al., 2020; Meier & Sannajust, 2021), psychology (Fan-Osuala, 2021; Obschonka et al., 2020; Toschi et al., 2023), and management studies (Ferraris et al., 2020; Ge & Zhao, 2022; Vossen & Ihl, 2020), while truly entrepreneurship-specific theorization is rare (Li et al., 2022; Zhang & Van Burg, 2020). Going forward, scholars should either develop new theories or reinterpret extant frameworks in the context of AI-enabled entrepreneurship. For example, from the perspective of upper echelon theory, research could explore the cognitive, decision-making, and behavioral dynamics of human-machine collaboration within founding teams; from the viewpoint of resource dependence, investigations might examine how AI alters startups' dependencies on external environments; and under institutional theory, studies could analyze how startups use AI to secure legitimacy and pursue growth.

(6) From a methodological standpoint, the technological approaches in AI-enabled entrepreneurship research require deeper integration, and future studies must furnish robust data, tools, and methods to support this field. At present, traditional methods, such as qualitative inquiry and survey-based empirical work, dominate, owing to the difficulty of accessing entrepreneurial data and the paucity of rich data sources. Moving forward, researchers should use AI technologies and large pretrained models to enable comprehensive collection, rapid analysis, and feature extraction across heterogeneous entrepreneurial data modalities, including text, speech, image, and video, to establish a solid multimodal data

foundation. Building on this groundwork, interdisciplinary methodologies can be employed to deploy and evaluate diverse AI technologies in testing hypotheses related to opportunity discovery and creation, resource integration, and value co-creation in entrepreneurship (Lévesque et al., 2022).

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