Library Progress International
Vol.44 No.3, Jul-Dec 2024: P.4812-4822

Print version ISSN 0970 1052
Online version ISSN 2320 317X

Original Article

Available online at www.bpasjournals.com

Innovation at the Intersection: Examining Artificial Intelligence's Impact on Entrepreneurship through Literature Synthesis

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How to cite this article: Varsha Shukla, Chandra Prakash Agrawal, Ravi Kumar Sharma, Surya Prakash Agarwal (2024). Innovation at the Intersection: Examining Artificial Intelligence's Impact on Entrepreneurship through Literature Synthesis. *Library Progress International,* 44(3), 4812-4822.

ABSTRACT

Purpose: While the transformative capabilities of artificial intelligence (AI) are increasingly acknowledged for their beneficial effects on entrepreneurship, there exists a notable absence of structured analysis within academic discourse concerning this relationship. This study aims to investigate how AI serves as a catalyst for entrepreneurial endeavors, with a specific focus on its integration across various Industry 4.0 technologies like smart factories, the Internet of Things (IoT), augmented reality (AR), and blockchain.

Design/methodology/approach: Employing a systematic literature review, this research examines relevant studies elucidating the intersection of AI and entrepreneurship. The analysis is organized around a novel framework termed the "AI-enabled entrepreneurial process."

Findings: The study demonstrates that AI significantly influences entrepreneurship, particularly enhancing opportunities, decision-making processes, performance metrics, and educational/research endeavors for entrepreneurs.

Practical implications: The framework proposed herein offers actionable insights for researchers, entrepreneurs, and individuals engaging in entrepreneurial activities within established entities, providing guidance on harnessing AI's potential within entrepreneurial contexts.

Originality/value: This research contributes a cohesive model for understanding the impact of AI on entrepreneurship, consolidating fragmented studies and categorizing contributions within the realms of entrepreneurial and managerial literature.

INTRODUCTION

We are at the dawn of a transformative phase in industrial history. While the Third Industrial Revolution introduced computers into manufacturing, the advent of Industry 4.0 marks a paradigm shift. This new era, driven by technological advancements and forward-looking models, is defined by the creation of intelligent, automated systems and fully digitized production processes (Muhuri et al., 2019).

Industry 4.0 represents a departure from traditional manufacturing, where machines executed predefined tasks, to a world where machines communicate with each other, monitor their own performance, and collaborate autonomously (Oztemel and Gursev, 2018). This evolution enables faster, more flexible, and efficient manufacturing processes, resulting in higher-quality, customizable products. Consequently, it enhances productivity and stimulates industrial growth (Schlick, 2014).

At the heart of this revolution is artificial intelligence (AI). AI is essentially the demonstration of intelligence by machines and involves the use of algorithms and digital systems to perform complex tasks, often surpassing human capabilities in reasoning, problem-solving, and adapting to dynamic environments. This concept, initially defined by John McCarthy over 60 years ago, has evolved significantly, encompassing the development of intelligent machines (Andersen, 2002; McCarthy, 1958). Machine learning, often viewed as a subset of AI, includes deep learning, which has emerged as a key driver within this domain (Obschonka and Audretsch, 2020).

However, this industrial revolution also demands changes in organizational structures (Manesh et al., 2021). AI integration has led to a renaissance of human labor in some of the most automated workplaces. By automating routine tasks, AI liberates human creativity, allowing workers to engage in more meaningful, less mechanical roles. It empowers individuals with tools that enhance their capabilities, potentially re-humanizing work and enabling more authentic human engagement (Daugherty and Wilson, 2018).

On the flip side, AI presents challenges for organizations grappling with heightened productivity demands and the pressure to remain competitive. As seen in previous waves of automation, there is a risk of job displacement and growing inequality, echoing the disruptions caused by mechanical and digital automation in manufacturing and retail sectors (Chalmers et al., 2021).

Thus, the primary challenge lies in maximizing the advantages of AI in terms of opportunities and productivity while minimizing its potential drawbacks, such as job loss and increased inequality (Makridakis, 2017). AI's impact on society will be both positive and negative, with entrepreneurs playing a pivotal role in shaping how these technologies are utilized. The academic discourse surrounding AI and entrepreneurship remains diverse, presenting a fertile ground for further exploration (Lévesque et al., 2020). This paper, therefore, aims to conduct a systematic review of the literature on the relationship between AI and entrepreneurship, providing insights for future research directions.

Several factors highlight the timeliness of this inquiry. First, there is a need to synthesize and organize the vast academic contributions related to this topic. To our knowledge, this study is the first of its kind, despite the existence of significant prior work (Chalmers et al., 2021; Obschonka and Audretsch, 2020).

Second, AI's increasing accessibility offers unprecedented opportunities for entrepreneurs. AI solutions, once seen as cutting-edge and exclusive to large firms, are now more affordable and widespread, allowing even smaller enterprises to leverage its power (Iansiti and Lakhani, 2020). This democratization of AI can greatly stimulate entrepreneurial activity.

Third, the COVID-19 pandemic has accelerated the adoption of digital technologies, including AI. Public health measures, such as lockdowns, forced organizations to embrace remote and automated processes, driving a shift in how work is conducted (Ratten, 2020). Additionally, significant financial resources have been allocated to support digital transformation, particularly in Europe, where the Next Generation EU (NGEU) recovery plan provides €750 billion for reforms and investments, with a focus on digitalization (Crescenzi et al., 2021). This creates unique opportunities for entrepreneurs to drive the digital transformation of their businesses using public subsidies and financial support.

This paper offers two key contributions. First, at a theoretical level, it is the first study to systematically review the literature on AI and entrepreneurship. Through a detailed analysis, we identified four key clusters that capture the positive impact of AI on entrepreneurship: “opportunity,” “decision-making,” “performance,” and “education

and research." These themes are examined within the framework of the "AI-enabled entrepreneurial process."

Second, we propose a framework to assess AI's impact on entrepreneurship, highlighting specific areas of future interest. This framework can serve as a guide for researchers, entrepreneurs, and those looking to harness AI's potential within established organizations.

The remainder of this paper is structured as follows: First, we discuss the relationship between AI and entrepreneurship. Next, we outline the methodology used in our analysis. In the fourth section, we present the results of the cluster analysis, followed by a framework to interpret AI's impact on entrepreneurship. Finally, we conclude by outlining the study's limitations and future research directions.

Linkage of AI with Entrepreneurship

The concept of "Industry 4.0," first introduced by Kagermann et al. (2011), merges the physical and digital worlds, emphasizing advanced engineering technologies such as robotics, automation, and digitalization. While AI and automation have been topics of research since the 1950s, particularly through theoretical machine learning models, the advancements of Industry 4.0 have provided a practical platform for bringing these theories to life (French et al., 2021).

AI has become a key area of focus in this technological revolution, with its applications expanding across industries where human intelligence is traditionally required (Oztemel and Gursev, 2018). AI plays a foundational role in the Industry 4.0 framework, powering "smart factories" where interconnected systems handle manufacturing processes with minimal human intervention. In these environments, AI drives data generation, transmission, and analysis, ensuring automated machines are intelligently managed, production flows are optimized, and outcomes are consistently high in quality (Lasi et al., 2014). Additionally, AI schedules machine interventions, designs operational workflows, oversees quality control, and automates maintenance tasks (Meziane et al., 2014; Murray, 1999).

AI also underpins the Internet of Things (IoT), a network of interconnected physical devices capable of communicating and interacting with each other remotely (Ashton, 2009). AI enables IoT by processing vast amounts of data, turning it into actionable insights while managing the software protocols that govern device communication (Ahmad et al., 2021).

In augmented reality (AR), AI enhances the interaction between real and virtual 3D objects in real time, improving image processing accuracy and reliability in AR applications (Azuma et al., 2001; Sahu et al., 2020). Additionally, AI is linked with blockchain technology, where secure, decentralized digital ledgers can support trusted AI decision-making through access to securely shared data (Treiblmaier, 2018; Dinh and Thai, 2018).

These technological advancements are reshaping the landscape of entrepreneurial ventures, particularly in the context of new business creation (Elia et al., 2020). AI holds significant potential for entrepreneurs, transforming how they develop, design, and scale their enterprises throughout the entrepreneurial journey (Chalmers et al., 2021). As with any disruptive innovation, AI empowers entrepreneurs to identify new opportunities and introduce novel products or services (Obschonka and Audretsch, 2020).

AI techniques also enhance entrepreneurial decision-making, improving the quality, effectiveness, and efficiency of choices, which in turn boosts operational performance (Kraus et al., 2020). Beyond benefiting AI-driven companies, AI encourages more traditional businesses to integrate AI-based solutions into their models, pushing them toward digital transformation. This era of AI presents a unique and historic opportunity for entrepreneurs, offering unprecedented possibilities for innovation and growth (Iansiti and Lakhani, 2020).

Methodology

To ensure a thorough and precise analysis of the intersection between entrepreneurship and AI, we conducted a

systematic literature review following an established guidelines.(Tranfield et al., 2003). Our search process involved crafting a comprehensive query comprising terms relevant to both entrepreneurship and artificial intelligence (AI). For entrepreneurship, we encompassed various forms of the term ("entrepreneur*") along with "venture creation." And regarding AI, we included the acronym "AI" and its subsets like "machine learning" and "deep learning." The final query read: ("entrepreneur*" OR "venture* creation") AND ("artificial intelligence" OR "AI" OR "A.I." OR "deep learning" OR "machine learning").

This review encompassed English-language peer-reviewed journal articles published up to December 31, 2022 (David and Han, 2004; Light and Pillemer, 1984), across three prominent databases: Scopus, Web of Science, and EBSCO. We conducted searches within the titles, abstracts, and keywords of articles.

Initially, our search yielded 433 papers, distributed across the databases as follows: 257 entries on Scopus, 111 on Web of Science, and 65 on EBSCO. In the subsequent phase, we precisely identified and removed duplicate studies, amounting to 102 papers, resulting in a refined pool of 331 papers.

Subsequently, we methodically scrutinized the abstracts of these papers. Through this process, we excluded 271 studies that did not align with our research focus: 65 papers lacked relevance to AI, 85 did not address entrepreneurship, and 121 failed to establish a connection between the two topics.

Following these rigorous steps, we arrived at a final selection of 60 articles. These comprised 24 theoretical papers, 31 empirical (quantitative) papers, and 5 empirical (qualitative) papers. This comprehensive review process ensured the inclusion of pertinent studies and facilitated a nuanced understanding of the relationship between entrepreneurship and AI, laying the groundwork for our subsequent analysis and framework development.

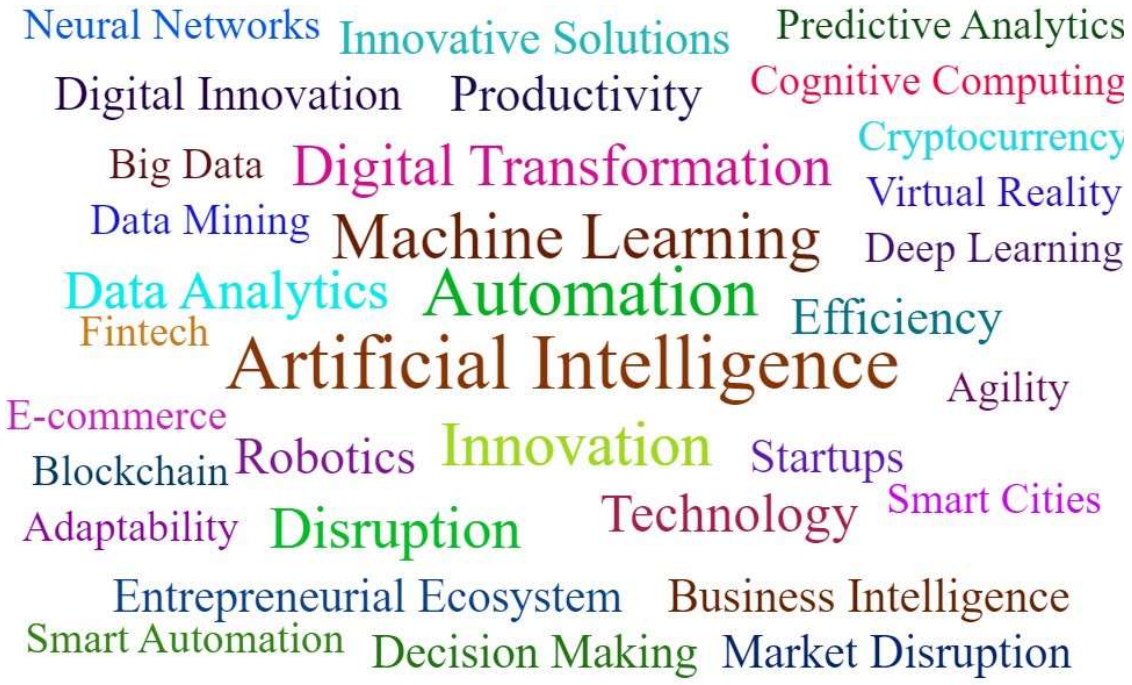

Fig 1: Word cloud generated after text analysis of selected articles.

Results of the Systematic Literature Review

Our systematic literature review encompassed 60 papers, which we categorized into four distinct clusters representing the varied impact of AI on entrepreneurship. Each paper could contribute to multiple clusters based on its focus areas. These clusters include:

Opportunity Cluster: Comprising 11 papers, this cluster explores how AI serves as a catalyst for entrepreneurs to identify and capitalize on new business opportunities. AI, coupled with big data, acts as an external enabler for entrepreneurial activities, facilitating the introduction of innovative products/services and business models (Obschonka and Audretsch, 2020). The integration of AI with the Internet of Things (IoT) further expands entrepreneurial possibilities, unlocking new avenues for digital entrepreneurship and sensor-based ventures (Elia et al., 2020). These advancements not only transform existing industries but also create novel opportunities,

fueling economic growth and innovation (Mamedov et al., 2018).

Decision-Making Cluster: Consisting of 24 papers, this cluster delves into how AI enhances decision-making processes for entrepreneurs. By harnessing the power of data and predictive analytics, AI enables entrepreneurs to make informed decisions with greater accuracy and efficiency (Kraus et al., 2020). Machine learning algorithms aid in market analysis, customer segmentation, and product forecasting, empowering entrepreneurs to navigate uncertainties and optimize business strategies (Suguna et al., 2019; Ramesh et al., 2018). Moreover, AI facilitates fundraising endeavors, providing insights into crowd funding project outcomes and enhancing investors' decision-making processes (Wang et al., 2020b).

Performance Cluster: With 18 papers, this cluster focuses on the tangible improvements AI brings to firm performance. AI-driven innovations optimize core business operations, enhance productivity, and drive revenue growth (Iansiti and Lakhani, 2020). By leveraging AI technologies such as facial recognition and predictive analytics, organizations gain competitive advantages, streamline processes, and deliver superior customer experiences (Mariani, 2019; Ahmad et al., 2019).

Education and Research Cluster: This cluster, comprising 12 papers, addresses the theoretical debates and evolutionary trends in entrepreneurship, influenced by AI advancements. It explores the implications of AI for educational institutions and research methodologies, reflecting on the transformative impact of AI on the entrepreneurial landscape (Nie, 2020).

Our analysis unveils a coherent framework, the "AI-enabled entrepreneurial process," where the opportunity, decision-making, and performance phases represent sequential stages propelled by AI, while education and research act as accelerators shaping the entire process. Through these clusters, AI emerges as a pivotal force driving entrepreneurial endeavors, shaping business models, enhancing decision-making capabilities, and fostering economic growth.

Therefore AI technologies are pivotal in driving digital transformation and understanding their strategic impact is imperative for decision-makers driving business success (Cantú-Ortiz et al., 2020).

The digital modernization of higher education may decrease the demand for academic staff, potentially leading to unemployment. However, this shift towards digitalization, driven by Industry 4.0 technologies, could spur the emergence of new educational services, such as AI training for businesses, provided by entrepreneurial universities. This has the potential to boost university entrepreneurship and create employment opportunities in AI-related fields, independent of student numbers (Bogoviz et al., 2019).

The emerging research streams focus on the implications of the data revolution and AI advancements on entrepreneurship. These developments not only offer new opportunities but also pose challenges and open questions. AI and big data are expected to enrich entrepreneurship research methodologies and influence the study of entrepreneurial phenomena, potentially bridging the gap between research and practice (Obschonka and Audretsch, 2020).

The ongoing datafication and rapid progress in AI are revolutionizing various aspects of society, including research methodologies. Algorithmic models are uncovering previously unseen structures and leveraging real-time data sources, thereby enhancing the accuracy and value of entrepreneurship research (Prüfer and Prüfer, 2019).

Research suggests that the fields of AI and big data offer valuable insights for entrepreneurship through cross-pollination. For instance, lessons from AI branches like genetic algorithms can inform entrepreneurial research by providing solutions to complex problems (Zhang and Van Burg, 2020).

AI holds promise in detecting entrepreneurial potential more effectively than human experts, but it also presents methodological challenges. Despite its benefits, scholars need to be well versed in the intricacies of AI to effectively utilize it in entrepreneurship research (Zhang and Van Burg, 2020).

AI holds immense potential for advancing entrepreneurship research, offering both significant benefits and challenges. As a tool for measurement, AI can assess the entrepreneurial potential of individuals or projects with greater accuracy than human experts, given the natural limitations of human cognition in such evaluations. However, the integration of AI into this field also presents methodological hurdles. One key issue is the need for entrepreneurship scholars to understand the human-AI interaction, ensuring that AI-driven analysis is guided by human insight. Additionally, collaboration with experts in computing and data analytics will be crucial for entrepreneurship researchers to fully leverage emerging AI techniques and technological infrastructure.

In this sense, AI represents both a powerful opportunity and a complementary tool to traditional research methods, enhancing the depth and relevance of entrepreneurship studies when used effectively (Lévesque et al., 2020).

sA common misconception is that intelligent systems will eventually replace humans across various sectors. While this might hold true for some roles and certain functions that can be automated, the true potential of AI lies in its ability to complement and enhance human capabilities rather than replace them. Human strengths—such as creativity, improvisation, dexterity, judgment, and social and leadership skills—remain vital and irreplaceable, just as AI brings advantages in speed, accuracy, repetition, prediction, and scalability (Daugherty and Wilson, 2018).

This complementarity applies to entrepreneurship as well, where individuals identify and seize business opportunities through the creation of new ventures (Shane and Venkataraman, 2000). To deepen the analysis and outline future research paths, we applied a method commonly used in recent studies (e.g., Flamini et al., 2021; Pellegrini et al., 2020). This involved comparing the results of clustering with theoretical models already established in academic literature.

For this analysis, we adopted a recent theoretical model designed to interpret AI's role in entrepreneurship (Chalmers et al., 2021). This model is structured into five components spread across three levels: the antecedents of venture formation, firm-level activities, and entrepreneurial outcomes. Specifically:

1. **Antecedents**: This phase refers to entrepreneurial intentions, where AI has the potential to influence both the likelihood of an individual starting a venture and the type of venture they pursue.
2. **Prospecting**: This stage highlights how AI algorithms can be leveraged to identify and capitalize on entrepreneurial opportunities.
3. **Organizational Design**: Focuses on new organizational structures and decision-making systems, emphasizing AI's role in automating decisions and suggesting actions based on available data.
4. **Exploiting**: Centres on enhancing productivity, performance, and rapid growth, specifically demonstrating AI's role in improving sales processes and enabling rapid scaling.
5. **Outcomes of venture creation**: This final part relates to the rewards entrepreneurs can gain. AI enables technologically adept entrepreneurs to achieve higher financial returns with less effort compared to more traditional entrepreneurial methods.

We mapped our four thematic clusters onto the five components of Chalmers et al.'s (2021) framework to pinpoint the most critical emerging areas that remain underexplored, providing promising directions for future research.

	Antecedents of entrepreneurship	Prospecting	Organizational design	Exploiting	Outcomes of entrepreneurship
Education and research	AI implemented in digital learning as an enabler for antecedents of venture creation				AI combined with ethics as an enabler for outcomes of venture creation
Opportunity		AI coupled with Neuro Science as an enabler for opportunity spotting and exploitation			
Decision making			AI applied to Entrepreneurs		

		communication as an enabler for fundraising	
Performance			AI used alongside block chain as an enabler for automation and scaling

Table 1: Framework for AI-enabled entrepreneurial process

The integration of AI into entrepreneurship education holds great potential to enhance learning, foster entrepreneurial mindsets, and drive venture creation. AI-driven teaching methods, including experiential learning and interactive tools, can engage students more deeply, allowing them to develop practical skills and entrepreneurial aspirations. However, challenges such as the need for digitally skilled educators and sufficient funding for AI resources in schools must be addressed to fully realize AI's educational potential. Future research should explore how academic curricula can be adapted to harness AI for entrepreneurship education, shaping a tech-savvy and innovative workforce.

Beyond education, AI's application in understanding entrepreneurial cognition presents exciting possibilities. Paired with neuroscience, AI could offer valuable insights into how entrepreneurs identify and evaluate opportunities, leveraging both hemispheres of the brain to combine creativity and knowledge.

AI can also enhance decision-making processes, particularly in communication, by analyzing behaviors that impact entrepreneurial finance. For example, AI can help entrepreneurs improve their pitches and communication strategies to secure funding, while also aiding investors in making informed decisions.

Additionally, AI's integration with blockchain technology could revolutionize business processes, facilitating automation, data security, and scaling in industries like Industry 4.0. While AI presents opportunities, ethical concerns such as inequality and unemployment must be addressed. Educators and researchers should prioritize ethical education in AI-related curricula, ensuring responsible use of technology. Future research should investigate how entrepreneurs can maximize AI's benefits while mitigating its risks, and explore how AI and entrepreneurs will collaborate to drive innovation in the digital age.

Conclusion

To our knowledge, this is the latest study to systematically map and analyze academic literature on the relationship between AI and entrepreneurship. To address the gap in the research, we conducted a systematic review of 60 articles, focusing on AI as an enabler for entrepreneurs. Our findings highlight the profound impact AI has on entrepreneurship, identifying four key phases of the “AI-enabled entrepreneurial process.” First, in the "opportunity" phase, AI helps entrepreneurs generate new opportunities. Second, in the "decision-making" phase, AI enhances prediction accuracy, leading to better decisions. Third, in the "performance" phase, AI improves business operations. Finally, the "education and research" phase accelerates the entire process by bridging the gap between entrepreneurial theory and practice.

This research offers a framework to interpret AI's influence on entrepreneurship, benefiting researchers, entrepreneurs, and aspiring innovators alike. It also provides a research agenda to explore future technological advancements and challenges. While the study's limitations include exclusion criteria in the review and the relatively nascent nature of the field, this research sets a benchmark for further exploration in this promising area. Scholars are encouraged to expand on this work, analyzing additional impacts AI may have on entrepreneurship in the future.

In conclusion, we believe we are at the dawn of a new industrial era, where today's entrepreneurial decisions will shape tomorrow's landscape. AI's greatest strength lies in enhancing human abilities, allowing it to manage routine tasks more efficiently, freeing entrepreneurs to focus on creativity, empathy, and vision—qualities no algorithm can replicate. Therefore, AI is not a threat but a powerful enabler for entrepreneurial innovation.

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