How Does AI-Driven Knowledge Management Enhance Sustainability of Startups? A Conceptual Framework

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Abstract: In response to growing sustainability imperatives and environmental uncertainties, startups are increasingly expected to embed green values into their strategic and operational processes. However, their limited resources, organisational learning base, and process maturity often hinder their capacity to achieve sustainable competitive advantage. Drawing on an integrative review of the literature, the study conceptually examines how AI-driven knowledge management (KM) contributes to the sustainability of startups. Based on the Resource-Based View and Dynamic Capability Theory, this paper identifies and integrates six core constructs: Green Entrepreneurial Orientation (GEO), Green Knowledge Management (GKM), Dynamic Capabilities (DCs), Big Data Analytics and Artificial Intelligence (BDA-AI), and Sustainable Competitive Advantage (SCA). These constructs are synthesised into a conceptual model that explains the mechanisms through which green strategic intent and knowledge practices interact with digital enablers to foster sustainable advantage. The proposed model highlights three key pathways. First, GEO is positioned as a strategic antecedent that directly enhances GKM and SCA, indicating that a green entrepreneurial mindset can drive sustainability-oriented knowledge processes and competitive outcomes. Second, GKM enhances DCs, which in turn contributes to SCA, with DCs mediating the GKM-SCA relationship, reinforcing the role of dynamic adaptability in transforming knowledge into sustainable advantage. Third, BDA-AI is proposed as a moderator that strengthens the effects of GKM on DCs and DCs on SCA by accelerating sensing, learning, and reconfiguration processes, particularly in uncertain and resource-constrained environments. Building upon these interrelationships, eight hypotheses are developed to construct the conceptual framework and provide a basis for future empirical validation. This study advances the theoretical discourse on sustainable entrepreneurship by integrating sustainability, KM, and AI perspectives. It offers practical insights for startups and policymakers seeking to leverage digital technologies for long-term viability. While conceptual, the proposed model provides a foundation for empirical validation and future refinements to account for contextual dynamics such as industry-specific challenges and policy influences.

Keywords: Green knowledge management, Artificial intelligence, Sustainable competitive advantage, Green Entrepreneurial orientation, Dynamic capabilities, Startups

1. Introduction

In an era marked by environmental degradation and social complexity, the imperative for sustainable development has extended to every tier of the global economy. Despite their agility and innovation potential, startups often lack the structural resources and capabilities required to navigate uncertainty and achieve long-term sustainability (Pöhlmann et al., 2025). This raises a central question: how can startups build and sustain competitiveness in resource-constrained, volatile environments?

Knowledge Management (KM), defined as the systematic processes of capturing, organising, sharing, and applying knowledge of an organisation (Davenport and Prusak, 1998), has long been recognised as a driver of innovation, adaptability, and performance (Scarso and Bolisani, 2024). For startups, harnessing knowledge assets efficiently is crucial to survival and success (Agostini et al, 2023). However, traditional KM often falls short of supporting the dynamic, sustainability-oriented needs of new ventures, as it tends to prioritize static efficiency over adaptive innovation (Rauter et al, 2017) and fails to leverage data-driven capabilities for sustainability-focused decision-making (Mikalef et al, 2019). The emergence of AI, with its capabilities in data processing, learning, and decision support, offers new possibilities to revitalise KM practices (Mikalef and Gupta, 2021).

Despite the growing adoption of AI across business domains (Thayyib et al, 2023), its application within KM, particularly in the context of startup sustainability, remains underexplored (Zahra, 2021). Most existing studies examine AI, KM, or startup sustainability as isolated domains (Alfiero et al, 2025), leaving theoretical and practical gaps. This study seeks to address this gap by developing a conceptual framework to explain how AI-driven KM can enhance the sustainability of startups. Specifically, two central research questions guide this

inquiry: (1) Why do startups often fail to attain sustainable competitive advantage? and (2) How can AI-driven KM support the development of sustainability-oriented capabilities? Grounded in the Resource-Based View (RBV) and Dynamic Capability Theory (DCT), the framework conceptualises AI-driven KM as a strategic enabler of dynamic capabilities and green knowledge assets. Through a critical review of the literature, six interrelated constructs are identified: Green Knowledge Management (GKM), Green Entrepreneurial Orientation (GEO), Dynamic Capabilities (DCs), Big Data Analytics (BDA), Artificial Intelligence (AI), and Sustainable Competitive Advantage (SCA).

This study contributes in three ways. First, it integrates AI, KM, and sustainability into a cohesive model tailored to startup contexts. Second, it advances theory by linking RBV and DCT with BDA-AI technologies to explain how startups develop adaptive, sustainability-enabling capabilities. Third, it introduces GEO and positions BDA-AI as a moderator, highlighting strategic and technological levers for sustainable entrepreneurship. These contributions offer a foundation for future empirical work and practical guidance for startups pursuing sustainable growth.

The next sections are structured as follows. Section 2 reviews the theoretical foundations and key literature on KM, AI, GEO, and sustainability in startups. Section 3 outlines the research methodology, including the approach to measuring constructs. Section 4 presents the conceptual development and formulates the research hypotheses, highlighting key interrelationships among GEO, GKM, DCs, BDA-AI, and SCA. Section 5 introduces the proposed conceptual framework, integrating these constructs into a unified model. Finally, Section 6 concludes the study, discussing theoretical contributions, practical implications, limitations, and directions for future research.

2. Literature Review

This section critically reviews the theoretical and empirical literature on integrating KM and AI to enhance startup sustainability. It introduces the RBV and DCT as theoretical foundations, explores the role of KM and AI, examines GEO's contribution to SCA, and highlights existing research gaps.

2.1 Theoretical Foundations

This study draws on RBV and DCT to explain how startups strategically leverage knowledge and dynamic capabilities to pursue sustainability under uncertainty. These theories offer a robust lens to understand how AI-enhanced KM generates non-replicable advantages.

2.1.1 Resource-Based view (RBV)

RBV posits that sustainable competitive advantage arises from resources that are valuable, rare, inimitable, and non-substitutable (VRIN) (Barney, 1991). In startups, tangible resources are typically limited, making intangible assets, such as knowledge, routines, and entrepreneurial expertise, particularly critical (Alvarez and Barney, 2005). While RBV was traditionally applied to large firms, recent adaptations extend its relevance to startups by recognising the strategic importance of knowledge-based and digitally enabled resources (Nambisan et al, 2019). Technology-enhanced KM systems can augment the VRIN attributes of knowledge assets, transforming them into key drivers of sustainable growth (Helfat et al, 2023). However, RBV alone offers limited insights into how firms continuously adapt and reconfigure their resources in volatile environments, where DCT becomes essential.

2.1.2 Dynamic capability theory (DCT)

DCT complements RBV by emphasising the ability to sense opportunities, seize them through resource mobilisation, and transform organisational routines to adapt to change (Teece et al, 1997; 2007). These capabilities are crucial for startups navigating rapid technological shifts, market fluctuations, and evolving sustainability demands (Eisenhardt and Martin, 2000). AI-driven KM aligns with DCT by enabling real-time sensing (via analytics), efficient seizing (through decision automation), and continuous transformation (via knowledge-driven innovation) (Teece, 2018; Sheng et al, 2017). Thus, while RBV explains what resources matter, DCT explains how they can be reconfigured to maintain sustainable advantage. AI-enabled KM strengthens this process by facilitating adaptive learning and knowledge-based reconfiguration, positioning it as a strategic enabler for startup sustainability.

2.2 KM and Sustainability

Davenport and Prusak (1998) provided one of the earliest frameworks for KM, focusing on structured processes, whereas more recent perspectives highlight its role in fostering innovation and adaptability (Migdadi, 2022; Scarso and Bolisani, 2024). For startups, effective KM enhances innovation, learning, and adaptability, but traditional KM systems often fail to meet their needs.

2.2.1 Green knowledge management (GKM)

GKM incorporates environmental concerns into KM by embedding sustainability principles into knowledge processes and organisational culture (Robinson et al, 2006). It supports green innovation by fostering the creation, sharing, and application of environmental knowledge in startups (Wang et al, 2022; He et al, 2024). While promising, research on GKM has primarily focused on large firms, leaving its application in startups underexplored (Centobelli et al, 2017). Given startups' agility and innovative potential, GKM could serve as a strategic asset for sustainability. Yet empirical understanding of its effectiveness in resource-constrained contexts remains limited.

2.2.2 KM challenges in startups

Startups face structural barriers to KM, including informal routines, limited budgets, and a lack of codification practices (Oliva and Kotabe, 2019). The absence of institutionalised knowledge systems often leads to knowledge silos and loss of critical know-how during transitions or scaling phases (Centobelli et al, 2017). These challenges undermine long-term learning and adaptation. AI can mitigate these limitations by automating knowledge tasks, supporting tacit knowledge capture, and facilitating real-time decision support. This integration is further explored in the following section.

2.3 AI's Transformative Role

AI and BDA introduce a new paradigm in KM by enabling more intelligent, scalable, and adaptive systems. This is particularly relevant for startups seeking agility without sacrificing learning depth or process efficiency.

2.3.1 Big data analytics in KM

BDA bridges AI and KM by enabling the processing of large, diverse datasets in real-time. It enhances knowledge quality, relevance, and timeliness, contributing to better-informed decisions (Shabbir and Gardezi, 2020). In startups, BDA allows for data-driven insights into market trends, customer behaviour, and environmental risks, supporting strategic agility even with limited resources (Behl et al, 2019).

2.3.2 AI-driven KM

AI-driven KM uses machine learning, NLP, and predictive analytics to automate knowledge acquisition, personalise access, and support strategic planning (Taherdoost and Madanchian, 2023). It enables knowledge flow across decentralised teams, simulates future scenarios, and helps institutionalise learning in fast-changing environments (Jarrahi et al, 2023). For startups, key advantages include enhanced cognitive capabilities, scalability without increased overhead, and organisational knowledge retention. When aligned with sustainability, AI-driven KM becomes a foundation for dynamic, eco-conscious decision-making (Al Halbusi et al, 2025).

Beyond decision support, AI can directly drive innovation outcomes (Abu et al, 2024). Specifically, AI enhances green innovation by enabling predictive optimisation of energy and resource use, extracting sustainability insights from unstructured data through natural language processing, and supporting data-driven design improvements that align with environmental goals.

2.4 Green Entrepreneurial Orientation (GEO)

GEO reflects a firm's strategic commitment to environmental sustainability through green innovation, proactiveness, and risk-taking (Shehzad et al, 2023). These dimensions promote eco-conscious decisions and resource-efficient practices, improving environmental performance and stakeholder trust (Ameer and Khan, 2023). Though GEO research has focused more on mature firms, its application to startups shows promise. It can reduce costs through waste minimisation, build resilience, and support legitimacy in sustainability-focused markets (Yan and Hu, 2024). GEO also strengthens dynamic capabilities by aligning entrepreneurial orientation with green strategy execution.

2.5 Critical Synthesis and Research Gap

The literature underscores the potential of knowledge-based strategies and AI in achieving sustainable competitive advantage. However, studies remain fragmented across domains, AI, KM, sustainability, and entrepreneurship are often explored in isolation. There is limited understanding of how AI-enhanced KM interacts with GEO through the lens of dynamic capabilities (Mikalef et al, 2021; Al Halbusi et al, 2024) in volatile startup environments.

This study addresses this gap by integrating RBV and DCT into a unified framework that explains how AI-driven KM systems enable startups to align strategic resources, organisational agility, and sustainability goals. The framework aims to advance theory while offering practical insights into technology-enabled sustainable entrepreneurship.

3. Methodology

This section first presents an integrative literature review that distils the core constructs. It then summarises our measurement design, highlighting the use of adapted 5-point Likert scales and exemplar items to lay the groundwork for future empirical testing.

3.1 Integrative Review Approach

This study adopts a critical literature review methodology to develop a conceptual framework examining how AI-driven KM can enhance sustainable competitive advantage in startups. A systematic search of academic databases, including Scopus, Web of Science, and Google Scholar, was conducted to identify theoretical and empirical studies relevant to KM, AI, entrepreneurship, and sustainability.

Following established guidelines for integrative literature reviews (Torraco, 2016), this study screened relevant literature to extract key constructs and examine their roles in prior research, focusing on empirical studies. The review process focused on identifying how these constructs, such as green KM, AI, BDA, GEO, DCs, and SCA, have been positioned in the literature as antecedents, mediators, moderators, or outcomes. These relational insights were then used to develop theoretically grounded hypotheses.

Drawing on this synthesis, this paper proposed a conceptual framework to illustrate the potential pathways through which AI-driven KM may influence the development of DCs and ultimately contribute to SCA in startup contexts. This framework serves as a foundation for future empirical exploration.

3.2 Measurement of Constructs

All constructs in this study will be measured using 5-point Likert scales (1 = “strongly disagree” to 5 = “strongly agree”), with items to be adapted from established sources to ensure content validity. For Green Knowledge Management (GKM), we will include items such as “Employees in our firm have easy access to information on best environmentally friendly practices” (Khan et al., 2024; Yu et al., 2022). Green Entrepreneurial Orientation (GEO) will be tapped with items like “Our firm proactively seeks out green market opportunities even under conditions of uncertainty” (Jiang et al., 2018; Al Halbusi et al., 2024). To capture Dynamic Capabilities (DCs), we will draw on the sensing–seizing–reconfiguring framework, exemplified by “We continuously reconfigure our internal processes to respond to environmental changes” (Wilden et al., 2013; Jantunen et al., 2018). Big Data Analytics and Artificial Intelligence (BDA-AI) will be operationalised with items such as “We use predictive analytics to forecast and mitigate our environmental impacts” (Benzidia et al., 2021). Finally, Sustainable Competitive Advantage (SCA) will be measured by items like “Our green products/services achieve higher market share relative to competitors” (De Guimaraes et al., 2018).

4. Conceptual Development and Hypotheses

The critical review identified six recurring constructs that form the foundation of AI-driven sustainable advantage in startups: GKM, BDA-AI, GEO, DCs, and SCA. While widely discussed in the literature, these elements are often examined in isolation or within specific disciplinary silos. Table 1 summarises the primary variable relationships examined in this study, highlighting directional effects, core theoretical contributions, and representative supporting literature.

Table 1: Key Construct Interactions and Representative Studies

Pathway	Direction	Core Contribution	Representative Studies
GEO → GKM	Direct Effect	GEO stimulates green knowledge activities and systems	Shehzad et al (2023); Baquero (2024, 2025)
GEO → SCA	Direct, Indirect	Drives sustainable advantage, partly through knowledge practices	Pratono et al (2019); Habib et al (2021)
GKM → SCA	Innovation Enablement	Facilitates green innovation and long-term sustainability	Zhang (2024); Asbeetah et al (2025)
DCs → SCA	Capability Deployment	Translates dynamic capability into sustainable advantage	Li et al (2024); Ma et al (2025)
GKM → DCs → SCA	Mediating Influence	Channels green knowledge into dynamic capabilities to achieve sustainable advantage	Lin and Chen (2017); Qader et al (2022)
BDA-AI → (GKM → DCs), (DCs → SCA)	Moderating Influence	Strengthens knowledge processes and capability effectiveness	Yu et al (2022); Khan et al (2024)

4.1 The Effect of GEO on GKM and SCA

GEO, which combines environmental and market orientations, has been increasingly recognised as a strategic driver of sustainability. Recent empirical studies highlight GEO's influence on organisational processes and outcomes, particularly in shaping sustainability strategies and competitive advantage. Within this context, GEO also significantly affects GKM practices, such as green knowledge acquisition, sharing, and integration.

Empirical evidence confirms GEO's influence on both SCA and broader sustainable performance, often through mediating mechanisms such as inter-organisational learning (Pratono et al, 2019), KM (Alfandi et al, 2023), and market orientation (Habib et al, 2021). Furthermore, GEO directly enhances GKM (Shehzad et al, 2023) and its related components, including green knowledge acquisition (Baquero, 2025), KM capability (Baquero, 2024), and green knowledge sharing (Le and Zhang, 2024). These knowledge practices support the development of sustainability-enabling capabilities.

These findings suggest that GEO contributes directly and indirectly to SCA by fostering GKM activities that underpin strategic adaptability and innovation. For startups typically constrained by limited resources, environmental volatility, and heightened innovation pressure, embedding green values within entrepreneurial orientation and strategically leveraging knowledge processes may provide a viable route to achieving sustainable differentiation and long-term competitiveness.

Accordingly, the following hypotheses are proposed:

H1: GEO positively influences GKM in startups.

H2: GEO positively influences SCA in startups.

4.2 The Effect of GKM on DCs and SCA: The Mediating Role of DCs

As an extension of traditional KM, GKM plays a central role in developing organisational capabilities for sustainability. KM practices such as knowledge acquisition, sharing, and application have been widely recognised as enablers of SCA through their influence on green innovation and firm performance (Abbas and Sağsan, 2019), laying a foundation for aligning environmental goals with strategic execution.

Although studies focused specifically on GKM remain relatively scarce, recent research affirms its relevance. GKM significantly enhances green competitive advantage (Zhang, 2024) and corporate sustainability through mechanisms like green knowledge acquisition (Asbeetah et al, 2025) and green knowledge sharing (Zairbani and Kumar, 2025). These practices promote innovation-driven environmental performance and strategic positioning.

Dynamic capabilities are also critical in advancing sustainability. Green DCs have been linked to improved environmental and financial outcomes, particularly when aligned with green supply chain and knowledge management strategies (Li et al, 2024). The capacity to absorb and act on green knowledge enhances agility, an essential asset for startups navigating uncertainty.

Moreover, growing evidence suggests that GKM plays a formative role in developing DCs. GKM fosters sensing, seizing, and reconfiguring capabilities by facilitating the flow and application of sustainability-oriented knowledge (Teece, 2007). Lin and Chen (2017) empirically validated that green knowledge sharing strengthens

DCs, leading to enhanced innovation and competitive advantage, thus supporting the mediating role of DCs between GKM and sustainability outcomes. This finding aligns with DCT, which positions knowledge as a core enabler of adaptive capability.

Thus, GKM is posited to impact SCA both directly and indirectly through the development of DCs, leading to the following hypotheses:

H3: GKM positively influences SCA in startups.

H4: GKM positively influences DCs in startups.

H5: DCs positively influence SCA in startups.

H6: DCs mediate the relationship between GKM and SCA in startups.

4.3 The Roles of Big Data Analytics and Artificial Intelligence (BDA-AI)

In the evolving landscape of sustainable entrepreneurship, startups increasingly rely on data-centric technologies to improve decision-making and competitiveness. Among such technologies, BDA and AI have emerged as strategic enablers for KM, DCs, and SCA. Given their complementary roles, this study adopts the integrated construct of BDA-AI to reflect their synergistic contribution: BDA enables data collection, integration, and pattern recognition, while AI supports predictive learning, automation, and adaptive decision-making.

BDA-AI is often conceptualised as both a direct antecedent and moderating mechanism for organisational knowledge and capability development. From the RBV and DCT perspectives, BDA capabilities foster green absorptive capacity and GEO, promoting green innovation (Makhloufi, 2024). In the context of green DCs, BDA not only enhances environmental sensing and reconfiguration capacities but also contributes to agility in sustainable supply chains (Li et al, 2024). Similarly, AI adoption directly improves sustainable performance by promoting green innovation and facilitating knowledge sharing, particularly in high-impact sectors such as healthcare (Al-Balushi et al, 2025).

BDA-AI also enhances GKM systems by improving the capture, integration, and intelligent processing of sustainability-oriented knowledge. Aljehani et al (2024) found that BDA contributes to both KM and green innovation, which together mediate improvements in organisational outcomes. AI facilitates proactive innovation and trust-based KM (Al Halbusi et al, 2025; Abdulmuhsin et al, 2024) and has been shown to moderate the impact of GKM on green human capital and innovation adoption (Khan et al, 2024).

These findings position BDA-AI as a dual enabler in the startup context. Technically, it strengthens knowledge flows and dynamic capability effectiveness, enhancing firms' ability to sense, seize, and reconfigure resources in volatile environments (Warner and Wäger, 2019). Strategically, it amplifies the performance impact of green capabilities. For example, Yu et al (2022) confirmed that BDA moderates the relationship between green DCs and innovation, while integrated frameworks show that BDA-AI improves outcomes in green supply chains, ambidexterity, and sustainable manufacturing (Wang et al, 2025; Rashid and Rasheed, 2022).

For startups, this integration is especially critical. Operating with limited memory and volatile conditions, they benefit from BDA-AI's real-time learning, adaptive capacity, and ability to circumvent traditional growth limitations. These technologies enable rapid resource renewal and strategic agility, positioning startups to seize sustainability opportunities (Nambisan, 2017).

Based on these insights, the following hypotheses are proposed:

H7: BDA-AI positively moderates the relationship between GKM and DCs.

H8: BDA-AI positively moderates the relationship between DCs and SCA.

5. Proposed Conceptual Framework

Based on the proposed hypotheses and grounded in RBV and DCT, this study develops a conceptual framework that illustrates how AI-driven KM fosters sustainability-oriented competitive advantage in startups. As shown in Figure 1, the model integrates six key constructs (GEO, GKM, DCs, BDA-AI, and SCA), and captures their interdependencies.

GEO provides the strategic impetus for green knowledge activities, enhancing dynamic responsiveness and long-term competitiveness. GKM directly contributes to SCA and simultaneously strengthens DCs, mediating the impact of knowledge processes on sustainable outcomes. Meanwhile, BDA-AI serves as a dual enabler,

strengthening the links between GKM and DCs, and between DCs and SCA, by improving agility, insight generation, and resource reconfiguration.

The proposed framework outlines the mechanisms through which startups can strategically leverage AI-driven KM to pursue green innovation and sustainable advantage under conditions of uncertainty and constraint.

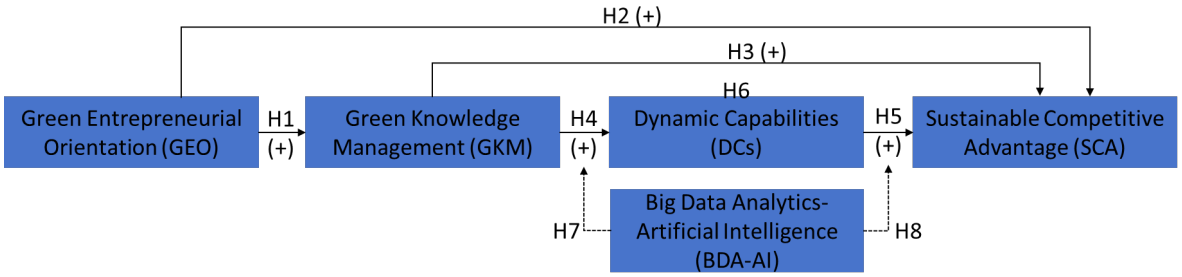

Figure 1: Conceptual Framework of AI-Driven KM for Sustainability in Startups

6. Conclusion

This study explores how AI-driven KM can enhance the sustainability of startups by integrating insights from RBV and DCT. A critical review of recent literature identified six core constructs (GEO, GKM, DCs, BDA-AI, and SCA) and synthesised them into a conceptual framework.

The findings suggest that GEO fosters sustainability-oriented knowledge practices, which enhance dynamic capabilities and support long-term competitive advantage. DCs serve as a vital conduit between green knowledge and performance outcomes, while BDA-AI technologies act as technical and strategic enablers that amplify agility and innovation in startup contexts.

Theoretically, this study contributes to the intersection of green entrepreneurship, KM, and AI by integrating previously fragmented concepts into an integrative framework. It extends the application of RBV and DCT in sustainability-focused startups operating under digitalisation pressures. However, as a preliminary conceptual study, this research primarily serves as a foundational step towards empirical validation. Practically, the proposed model offers guidance for startup founders and policymakers to strategically leverage BDA-AI and knowledge capabilities in pursuit of green growth and long-term advantage.

As a conceptual and literature-based study, it should be regarded as an initial step towards building a more robust empirical understanding of AI-driven KM in startup sustainability. The framework may have overlooked other relevant variables, such as external environmental factors (e.g., policy support or market dynamics), which could also influence the relationships among the core constructs. Future research may apply this framework to specific sectors (e.g., food tech or digital services) to examine contextual nuances and practical implementation. Longitudinal and comparative studies could further illuminate how AI-driven KM capabilities evolve and differ across organisational stages and settings.

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