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Green Innovation Capabilities and Sustainable SME Performance: An Integrative Literature Review

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Abstract

This integrative literature review asks how external pressures and organizational capabilities combine to support green innovation and multidimensional sustainable performance in small and medium-sized enterprises (SMEs). A transparent audit of the manuscript bibliography identified 62 cited entries; removing two duplicates and separating three institutional reports yielded 57 distinct scholarly sources for citation-based thematic synthesis, with recent evidence emphasized and seminal theory retained. The analysis compares external drivers, capability formation, product and process innovation, environmental and economic outcomes, digital complementarity, and contextual constraints. Across the reviewed evidence, stakeholder pressure and regulation are more likely to stimulate innovation when knowledge management, absorptive capacity, leadership, and green dynamic capabilities support implementation. Environmental gains are more consistent than short-term financial returns; firm size, financing, readiness, industry, and commercialization shape the variation. Digitalization and artificial intelligence are treated as conditional enabling capabilities, not automatic performance drivers. Drawing primarily on dynamic capability theory, the review proposes a six-stage green capability cycle that connects sensing, mobilization, innovation, measurement, learning, and resource reconfiguration. The cycle is a literature-informed conceptual proposition requiring longitudinal validation, not an empirically tested causal model.

Keywords: *digital transformation, dynamic capabilities, green innovation, SMEs, sustainable performance.*

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INTRODUCTION

Small and medium-sized enterprises (SMEs) occupy a strategically important position in contemporary economies because their cumulative activities influence employment, production networks, resource consumption, and environmental outcomes. Intensifying environmental regulation, stakeholder expectations, supply-chain requirements, and changing customer preferences have consequently increased pressure on SMEs to incorporate sustainability into their strategic and operational decisions (OECD, 2023; European Commission, 2022). Unlike large corporations, however, SMEs frequently operate with more limited financial resources, managerial specialization, technological infrastructure, and access to environmental expertise, making the transition toward greener business practices comparatively challenging (Schrank & Kijkasiwat, 2024; Shahin et al., 2024). These conditions indicate that sustainable transformation in SMEs cannot be understood merely as regulatory compliance but must instead be examined through the organizational capabilities that enable firms to identify environmental challenges, mobilize resources, and convert sustainability demands into economically viable innovations.

Green innovation has increasingly emerged as an important mechanism through which SMEs can simultaneously reduce environmental impacts and strengthen their competitive position. The concept encompasses innovations in products, processes, technologies, organizational practices, and business models that minimize resource consumption, emissions, waste generation, or other negative environmental effects while preserving or creating business value (Rodrigues & Franco, 2023;

Sikandar et al., 2024). Recent empirical studies indicate that green innovation can enhance market performance, environmental performance, competitive differentiation, and broader sustainability outcomes, although the magnitude and consistency of these effects vary across industries and institutional contexts (Rustiarini et al., 2022; Zheng et al., 2022; Ji et al., 2024). This growing body of evidence suggests that green innovation is increasingly becoming a strategic capability rather than an isolated environmental initiative, particularly for SMEs operating under competitive and resource-constrained conditions.

The review uses dynamic capability theory as its primary explanatory lens because green transformation requires SMEs to sense environmental change, mobilize scarce resources, and reconfigure routines over time (Teece, 2007; Singh et al., 2022). The natural-resource-based view explains the strategic relevance of environmentally valuable capabilities, while the resource-based view explains why capability endowments differ across firms (Hart, 1995; Barney, 1991). A stakeholder perspective locates regulatory and market pressure upstream of organizational responses, and absorptive capacity specifies how external information becomes actionable knowledge (Aboelmaged & Hashem, 2019). These perspectives perform complementary rather than interchangeable roles in the proposed cycle.

Recent studies further demonstrate that several complementary organizational capabilities determine whether green innovation produces sustainable performance. Knowledge management facilitates the acquisition, dissemination, and application of environmental information, while green transformational leadership and entrepreneurial orientation influence the strategic commitment necessary to convert knowledge into concrete innovation practices (Majali et al., 2022; Nasir et al., 2026). Social capital, employee behavior, organizational creativity, managerial discretion, and green information-technology empowerment have also been identified as mechanisms that can strengthen environmental innovation and sustainability outcomes among SMEs (Ooi et al., 2023; Setyaningrum et al., 2023; Omar et al., 2024). These findings demonstrate that green innovation capability represents a multidimensional organizational configuration rather than a single technological resource, requiring interaction among managerial, human, informational, relational, and technological resources.

Sustainable SME performance is similarly multidimensional and therefore requires a broader analytical perspective than conventional financial indicators alone. Environmental performance concerns reductions in energy consumption, emissions, waste, and material intensity, whereas economic performance reflects productivity, profitability, cost efficiency, market growth, and business resilience, and social performance includes employee and stakeholder-related outcomes (Yadegaridehkordi et al., 2023). Empirical evidence generally reports positive associations between eco-innovation or green innovation and SME performance, but the strength of these relationships differs across environmental, financial, strategic, and competitive outcomes (Al-Hanakta et al., 2023; Oduro, 2024). Meta-analytic and systematic-review evidence therefore supports the overall strategic relevance of green innovation while simultaneously indicating that its performance consequences depend on how innovation is embedded within the broader capability structure of the firm (Zheng & Iatridis, 2022; Oduro, 2024).

Contextual and organizational boundary conditions provide an additional explanation for the heterogeneous results reported in the literature. Sustainability readiness, firm size, investment capacity, access to finance, managerial commitment, regulation, and market conditions can determine whether SMEs are able to capture economic value from environmental innovation after initially bearing its implementation costs (Schrank & Kijkasiwat, 2024; Wasiq et al., 2023). Studies have also demonstrated that stakeholder pressure and environmental regulation can stimulate green innovation, although their effects become stronger when firms possess the capabilities required to interpret external demands and translate them into product, process, or organizational change (Singh et al., 2022; Xu et al., 2023). This conditionality helps explain why apparently similar green initiatives can generate strong sustainable-performance improvements in some SMEs but produce limited or delayed benefits in others.

An additional development concerns the increasing interaction between digitalization and green innovation capabilities. Digital technologies can support environmental sensing, resource monitoring, knowledge integration, operational optimization, and decision making, thereby improving the capacity of SMEs to identify and exploit opportunities for greener production and business models (Xu et al.,

2023; Farmanesh et al., 2025). Emerging studies further suggest that artificial intelligence and interconnected digital technologies can complement green innovation and strengthen sustainable competitiveness when they are integrated with organizational knowledge and environmental strategy rather than adopted as stand-alone technologies (Liu & Adil, 2026; Liu et al., 2026). The growing digital–green convergence reinforces the need for an integrative review that moves beyond isolated innovation practices and examines how multiple organizational capabilities collectively contribute to sustainable SME performance.

Prior syntheses establish that eco-innovation is generally associated with environmental and performance benefits, but they do not by themselves explain the timing and organizational sequencing of those outcomes (Zheng & Iatridis, 2022; Oduro, 2024; Sikandar et al., 2024). Four gaps motivate this review: a conceptual gap in how managerial, relational, and digital capabilities are configured; a mechanism gap between external pressure, innovation, and distinct performance outcomes; a contextual gap involving finance, firm size, sector, and readiness; and a temporal gap in evidence about capability renewal. The present contribution is an integrative, not a causally validated, model of feedback from performance measurement to learning and resource reconfiguration. This positioning distinguishes the proposed cycle from a static list of green innovation determinants.

The review addresses four questions: RQ1, which external pressures and internal capabilities enable green innovation in SMEs? RQ2, through which mechanisms does innovation relate to environmental, economic, social, and market performance? RQ3, which organizational and institutional conditions account for differences across findings? RQ4, how can digital enabling capabilities and performance feedback be integrated into a dynamic capability cycle? Green innovation denotes implemented environmental improvements in products, processes, or organizational practices; green innovation capabilities denote the routines and resources enabling those improvements. Green dynamic capabilities concern sensing, mobilizing, and reconfiguring those resources, while eco-innovation is used as a broader overlapping label rather than an exact synonym.

RESEARCH METHODS

This study is an integrative literature review with an auditable, citation-based corpus rather than a PRISMA-compliant systematic review. The source universe was reconstructed from the bibliography present in the submitted manuscript: 62 non-empty entries were identified, two repeated entries (Schrank & Kijkasiwat, 2024; Singh et al., 2022) were removed, and three institutional reports were separated as contextual sources. The resulting corpus contains 57 distinct scholarly publications appearing between 1991 and 2026, with analytical emphasis on work published from 2022 onward. Earlier studies were retained where needed to establish resource-based, natural-resource-based, dynamic capability, absorptive-capacity, and innovation foundations. The 57 publications comprise cited research, reviews, and theoretical works; this figure must not be interpreted as the number screened through an independently documented database search.

The manuscript identifies the terms “green innovation,” “eco-innovation,” “green dynamic capabilities,” “SME performance,” “sustainable performance,” “environmental performance,” and “small and medium-sized enterprises.” A replicable future search could combine ("green innovation" OR "eco-innovation" OR "green dynamic capability") AND (SME OR "small and medium enterprise") AND (sustainab* OR performance), with database-specific field and date restrictions. The original database names, execution dates, retrieved-record counts, duplicate-screening logs, and full-text assessment records were not available in the supplied files; no retrospective claims about Scopus/Web of Science searches or PRISMA screening totals are therefore made. The present evidence audit documents what can actually be verified: identification within the bibliography, removal of two citation duplicates, separation of three contextual reports, and thematic classification of 57 scholarly sources.

The classification criteria distinguish direct SME evidence from adjacent firm-level research and theoretical or review literature. Eligible scholarly sources address at least one relevant component: external environmental drivers, green capability development, green or eco-innovation, sustainability outcomes, digital enablers, or organizational boundary conditions; both quantitative, qualitative, conceptual, and review designs are considered. Institutional publications by the OECD (2023), European Commission (2022), and UNEP (2024) inform the background only and are not treated as studies substantiating a firm-level mechanism. Works with no clear relationship to the

analytical pathway are not used as stand-alone evidence of an SME-specific effect, even when they inform general theory.

Evidence was extracted into analytical categories covering publication type and stated context, theoretical lens, antecedent, capability, innovation form, outcome dimension, and relevant contextual condition. Studies were compared for convergent claims, conditional or apparently divergent findings, and plausible differences in industry, geography, measurement, and research design. Meta-analytic and systematic-review results inform broad directional conclusions; SME studies provide contextual mechanisms; conceptual and foundational sources inform theory but do not establish empirical effect size. No pooled effect estimates, independent full-text risk-of-bias scores, or unreported sample statistics are claimed, and the lack of a recoverable search audit trail is a methodological limitation.

The resulting synthesis proceeds from external pressure to capability mobilization, green innovation, and multidimensional performance, followed by measurement, learning, and reconfiguration. During interpretation, antecedents are distinguished from organizational mechanisms, digital and AI tools are treated as potential cross-stage enablers, and firm size, financing, readiness, sector, and institutional conditions are interpreted as candidate boundary conditions rather than proven universal moderators. The reference-based audit supports transparent conceptual integration but does not establish exhaustive literature coverage, a formal quality ranking, or causal identification.

RESULT AND DISCUSSION

External Environmental Pressure and the Formation of Green Innovation Capabilities

Small and medium-sized enterprises increasingly operate within institutional environments characterized by tighter environmental expectations from regulators, customers, supply-chain partners, financial institutions, and local communities. These external pressures can function as important triggers for organizational change because they alter the perceived costs and benefits associated with environmental investment. Singh et al. (2022) demonstrate that stakeholder pressure can stimulate green innovation when SMEs possess green dynamic capabilities capable of translating external expectations into strategic responses. This relationship indicates that environmental pressure should not be interpreted merely as a compliance burden, but as an external stimulus whose organizational consequences depend on the internal capacity of firms to recognize, interpret, and respond to environmental demands.

The effect of regulatory pressure is particularly important because SMEs often lack the institutional resources needed to anticipate and respond to changing environmental requirements. Xu et al. (2023) show that environmental regulation can encourage sustainable innovation, especially when it interacts with digitalization as a supporting organizational mechanism. Yu et al. (2022) similarly demonstrate that regional environmental regulation can shape the relationship between green innovation and the fulfillment of corporate social responsibility among manufacturing SMEs. These findings suggest that regulation may generate stronger innovation outcomes when it is accompanied by technological readiness, access to information, and sufficient organizational capacity to convert legal obligations into process and product improvements.

Market-related pressure constitutes another important driver of capability formation because environmental differentiation increasingly affects customer preferences, supply-chain access, and competitive positioning. Wasiq et al. (2023) find that several organizational and environmental factors influence green innovation adoption and subsequently affect sustainability performance among SMEs. Simmou et al. (2023) further show that green innovation can serve as a mechanism linking corporate social responsibility strategy with improved environmental performance in smaller firms. External market expectations therefore appear to reinforce green innovation when sustainability becomes connected not only with regulatory legitimacy but also with reputation, customer value, and long-term market participation.

External pressure alone, however, does not automatically generate innovation because SMEs differ considerably in their capacity to absorb and operationalize environmental knowledge. Earlier capability research emphasized that absorptive capacity allows firms to recognize the value of external information, assimilate it, and apply it to innovation activities, and this mechanism remains highly relevant to green innovation in resource-constrained enterprises. Aboelmaged and Hashem (2019) show that absorptive capacity contributes to green innovation adoption through sustainable organizational capabilities, while Albort-Morant et al. (2016) demonstrate that learning and capability

development are important antecedents of green innovation performance. The evidence therefore indicates that environmental knowledge becomes strategically valuable only when firms possess organizational routines that transform external information into applicable technological, managerial, or operational solutions.

Knowledge-management capability strengthens this conversion process by facilitating the acquisition, distribution, interpretation, and utilization of environmentally relevant information across organizational functions. Abbas and Sağsan (2019) show that knowledge-management practices contribute to green innovation and sustainable development by improving how organizations integrate environmental knowledge into decision-making processes. More recent SME evidence similarly associates knowledge management with organizational performance and competitive advantage through its interaction with green innovation (Achmad & Wiratmadja, 2025). This finding is particularly relevant for SMEs because managerial knowledge is frequently concentrated among a limited number of individuals, making systematic knowledge-sharing practices important for reducing dependence on individual expertise and improving organizational continuity.

Table 1. Comparative Evidence Matrix: External Pressure, Capabilities, and Context

Study / design	Country or context	External driver	Capability pathway	Synthesis and caveat
Singh et al. (2022); SME study	SMEs; setting not specified here	Stakeholder pressure	Green dynamic capabilities	Conditional pathway; no universal direct effect
Yu et al. (2022); SME study	Manufacturing SMEs	Regional regulation	Green innovation / CSR	Regulatory context differs by region
Xu et al. (2023); SME study	SMEs	Environmental regulation	Digitalization and innovation	Digital readiness may shape response
Wasiq et al. (2023); SME study	Saudi Arabia	Organizational / external factors	Green innovation adoption	Country-specific adoption evidence
Simmou et al. (2023); SME study	Maldives and Morocco	CSR strategy	Green innovation	Environmental endpoint, not financial proof
Achmad & Wiratmadja (2025); SME study	Indonesia	Knowledge resources	Knowledge / green innovation	Competitive outcomes; context matters
Mubeen et al. (2024); firm study	Business organizations	Environmental strategy	Green dynamic capability	SME transfer not established by title
Schrank & Kijkasiwat (2024); SME study	SMEs	Readiness / firm size	Resource preparedness	Firm size may condition returns

Source: Author's format from litterature.

Table 1 shows convergence in the proposed indirect mechanism: regulation, customer demands, and stakeholder expectations are less informative as predictors of performance unless capability formation is considered. The sources differ in setting, because the table includes Saudi, Indonesian, manufacturing, and cross-country SME studies as well as broader firm-level research. Their designs and dependent variables are not sufficiently comparable to infer a common effect size or an invariant mediation sequence. The synthesis therefore supports a conditional pressure–capability–innovation pathway rather than the claim that stronger environmental regulation uniformly improves all aspects of SME performance (Singh et al., 2022; Xu et al., 2023; Yu et al., 2022).

Green dynamic capability is particularly significant because it allows organizations to modify resource configurations when environmental conditions, technologies, and stakeholder expectations change. Mubeen et al. (2024) identify an important nexus between green dynamic capabilities, green innovation, and sustainable performance, suggesting that firms require adaptive organizational mechanisms rather than static environmental resources. Kiranantawat and Ahmad (2023) similarly conceptualize SME sustainability performance as being influenced by green dynamic capability through green innovation, organizational creativity, and agility. These findings expand the capability argument by showing that sustainability depends not only on the possession of knowledge or technology but also on the ability to continually recombine those resources as conditions change.

Leadership capability further determines whether external sustainability pressures are translated into organization-wide priorities. Majali et al. (2022) show that green transformational leadership and green entrepreneurial orientation are linked with SME performance through the mediating role of green product innovation. Leadership can therefore influence environmental outcomes by defining strategic priorities, legitimizing experimentation, allocating scarce resources, and encouraging employees to participate in green innovation activities. The role of leadership is especially important in SMEs because decision-making authority is frequently concentrated among owners or senior managers, causing managerial environmental commitment to exert a disproportionate influence on organizational behavior.

Human and relational resources also contribute to the development of green innovation capabilities because sustainability initiatives often require cooperation across internal and external organizational boundaries. Ooi et al. (2023) identify social capital and innovation as important influences on the environmental performance of manufacturing SMEs, while Khan et al. (2023) link green employee behavior, green capability, corporate social responsibility, and sustainable performance. Setyaningrum et al. (2023) further demonstrate that green creativity and green IT empowerment can contribute to sustainable SME performance and green competitive advantage. Collectively, these studies indicate that green capability formation is socially embedded and depends on employee engagement, collaborative relationships, managerial encouragement, and access to enabling information technologies rather than on environmental technology alone.

Organizational readiness ultimately determines how effectively SMEs can combine these multiple resources into sustained environmental action. Schrank and Kijkasiwat (2024) show that the performance effects of green innovation vary according to sustainability readiness and firm size, highlighting the importance of internal preparedness as a boundary condition. Shahin et al. (2024) similarly identify numerous barriers to green innovation in SMEs, demonstrating that resource shortages, managerial limitations, and organizational obstacles can inhibit implementation even when environmental pressures are strong. External pressure should therefore be understood as the starting point of a capability-building process in which knowledge, learning, leadership, social capital, digital support, and adaptive routines jointly determine whether environmental demands are converted into effective green innovation.

Collectively, the first theme identifies external pressure as an antecedent and green knowledge integration, leadership, absorptive capacity, and dynamic capability as plausible intervening mechanisms. A key point of disagreement concerns whether pressure acts primarily as a compliance cost or as an opportunity for innovation: the answer appears to depend on readiness, supplier access, and strategic discretion (Wasiq et al., 2023; Schrank & Kijkasiwat, 2024). The cross-sectional and context-specific designs summarized here cannot establish whether capabilities existed before pressure or developed in response to it. A remaining theoretical question is which capabilities are genuinely sequential prerequisites and which are substitutes or jointly reinforcing resources.

Green Innovation and Multidimensional Sustainable SME Performance

Green innovation affects SME performance through multiple pathways that extend beyond conventional financial outcomes. Product innovation can reduce environmental impacts through recyclable materials, improved durability, lower energy intensity, and reduced hazardous inputs, while process innovation can improve resource efficiency by minimizing waste, water consumption, emissions, and production losses. Rodrigues and Franco (2023) emphasize that green innovation in SMEs is closely associated with organizational adaptation and the integration of sustainability principles into products and operational routines. This multidimensional character suggests that the

performance consequences of green innovation should be evaluated simultaneously across environmental, economic, social, and strategic domains rather than through a single profitability indicator.

Environmental performance represents the most immediate and consistently reported outcome of green innovation because eco-innovative practices are explicitly designed to reduce ecological burdens. Rahmani et al. (2024), through meta-analytic evidence, identify a generally positive relationship between green innovation and environmental performance across accumulated empirical studies. Simmou et al. (2023) similarly demonstrate that green innovation can transmit the effects of corporate social responsibility strategies into stronger environmental outcomes among SMEs operating in different national contexts. These findings indicate that reductions in waste, pollution, energy consumption, and resource intensity constitute relatively direct benefits of innovation because such outcomes are closely connected with the technological and operational objectives of environmental initiatives.

Economic performance, however, is more conditional because green innovation frequently requires initial investment before financial gains become visible. Ji et al. (2024) find that green innovation can promote the financial performance of SMEs, although the ability to capture economic value depends on organizational and contextual conditions surrounding the innovation process. Al-Hanakta et al. (2023) likewise report that eco-innovation influences the business performance of micro, small, and medium-sized enterprises in the food-processing sector, suggesting that environmental innovation can create economic value when it improves efficiency, market positioning, or product attractiveness. The evidence therefore implies that green innovation should not be regarded as automatically profitable but as an investment whose returns depend on the fit between innovation expenditure, organizational capability, and market opportunities.

Market performance provides another important pathway through which green innovation can support SME sustainability. Zheng et al. (2022) demonstrate that green innovation can influence SME market performance by enhancing product differentiation and strengthening firms' ability to respond to environmentally conscious customers. Green products may enable SMEs to enter new market segments, satisfy supplier requirements, and improve their reputation among stakeholders seeking environmentally responsible business partners. Such benefits are particularly important in competitive markets where conventional cost advantages are difficult for smaller firms to sustain and environmental differentiation provides an alternative basis for positioning.

Competitive advantage becomes stronger when green innovation is embedded in organizational knowledge and capabilities that competitors cannot easily replicate. Setyaningrum et al. (2023) show that green creativity, organizational independence, and green IT empowerment contribute to sustainable SME performance and green competitive advantage. Lestari and Sunyoto (2023) similarly demonstrate that fostering green innovation can contribute to sustainable performance by aligning innovation activity with long-term organizational and environmental objectives. Green innovation can therefore create strategic value when it becomes a cumulative organizational capability rather than a one-time environmental project.

Table 2. Comparative Evidence Matrix: Innovation, Performance, and Interpretation

Study / evidence	Context / focus	Outcome measured	Reported relationship	Interpretive limitation
Al-Hanakta et al. (2023); SME study	Jordan; food processing	Business performance	Eco-innovation linked to performance	Sector- and country-specific
Ji et al. (2024); SME study	China; green innovation	Financial performance	Potential positive financial effect	Timing and investment matter
Zheng et al. (2022); SME study	SMEs; green innovation	Market performance	Environmental market differentiation	Not equivalent to profitability
Yadegaridehkordi et al. (2023); SME study	Malaysia; manufacturing	Environment / finance / social	Multidimensional determinants	Dimensions differ in definition

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Study / evidence	Context / focus	Outcome measured	Reported relationship	Interpretive limitation
Oduro (2024); meta-analysis	SME eco-innovation studies	Sustainable performance	Overall positive association	Pooled evidence not causal proof
Bhatti et al. (2023); SME study	Servitized SMEs	Business performance	Eco-innovation connects procurement and results	Service context limits generalization
Omar et al. (2024); SME study	Green manufacturing	Sustainable performance	Managerial discretion conditions pathway	Moderated mechanism; not universal
Rustiarini et al. (2022); SME study	SMEs	Firm performance	Reported positive association	Measurement / setting differ

Source: Author's format from litterature.

Table 2 highlights a crucial distinction between the direction of reported associations and their timing. Meta-analytic evidence supports an overall positive eco-innovation–performance relationship, whereas individual SME studies focus on different endpoints and contexts, including Chinese financial outcomes, market performance, and Malaysian multidimensional sustainability (Oduro, 2024; Ji et al., 2024; Zheng et al., 2022; Yadegaridehkordi et al., 2023). These outcomes are not interchangeable, and the table does not provide a basis for comparing effect sizes across research designs. The most defensible inference is that environmental improvements may be more directly observable than financial returns, which depend on investment recovery, commercialization, and firm resources.

The operational pathway linking innovation with performance is also shaped by supply-chain and production practices. Bhatti et al. (2023) demonstrate that eco-innovation mediates the relationship between sustainable procurement, packaging, distribution, and the performance of servitized SMEs, indicating that innovation can convert responsible operational practices into measurable organizational outcomes. Omar et al. (2024) similarly show that green innovation plays a mediating role between green manufacturing practices and sustainable SME performance, with managerial discretion affecting the strength of this mechanism. These findings suggest that green innovation is particularly valuable when it integrates otherwise fragmented sustainability activities into a coherent production and value-delivery system.

Sectoral characteristics further influence the ways in which sustainability-oriented innovation creates performance benefits. Kwak et al. (2023), examining sustainable innovation in a low- and medium-technology sector, demonstrate that SMEs can pursue meaningful sustainability improvements even outside high-technology industries where research-and-development intensity is typically greater. Rustiarini et al. (2022) likewise provide evidence that green innovation can improve SME performance, reinforcing the relevance of environmental innovation across different levels of technological sophistication. This evidence challenges the assumption that green innovation is restricted to technologically advanced firms and instead highlights organizational learning, adaptation, and resource recombination as central conditions for implementation.

The performance implications of green innovation must be assessed against costs and uncertainty rather than presumed to be uniformly positive. New equipment, employee training, certification, digital infrastructure, and supply-chain adjustment can increase short-run expenditure, while the returns from product differentiation may materialize later or not at all for poorly positioned firms (Ji et al., 2024; Li et al., 2025; Schrank & Kijkasiwat, 2024). Limited financing, resistance to changed routines, and technological lock-in are plausible failure mechanisms; unsupported environmental claims also create a greenwashing risk rather than a genuine performance gain. These considerations qualify a predominantly positive literature and underline the need to distinguish measured environmental improvements from reputational claims and realized financial returns.

Taken together, the evidence indicates convergence around the strategic relevance of green innovation but heterogeneity in its economic and market consequences. Studies differ in whether they examine manufacturing or service SMEs, assess green products or green processes, use contemporaneous or lagged performance indicators, and account for resource constraints (Bhatti et al.,

2023; Rustiarini et al., 2022; Omar et al., 2024). Financial non-significance or delayed benefits cannot be interpreted as proof that environmental innovation has failed, just as environmental improvements alone do not establish profitable commercialization. The unresolved question is when and through which capabilities process efficiency translates into financial resilience rather than merely additional compliance expenditure.

Digital–Green Complementarities and the Development of a Staged SME Capability Cycle

The contemporary sustainability transition increasingly requires SMEs to combine environmental capabilities with digital and technological resources rather than treating green innovation as an isolated operational agenda. Digitalization can improve environmental sensing by enabling firms to collect, process, and interpret information concerning energy consumption, material use, waste generation, customer preferences, and regulatory change. Xu et al. (2023) identify digitalization as an important catalyst of sustainable innovation, while Alraja et al. (2022) show that technological innovation and sustainable green practices can jointly contribute to SME sustainable performance under conditions of disruption. This evidence indicates that digital technologies create sustainability value when they strengthen organizational capabilities for monitoring, learning, coordination, and adaptive decision making.

Artificial intelligence and the Internet of Things can extend green capability development through sensing, forecasting, equipment monitoring, and operational optimization, but these functions are enabling inputs rather than sustainability outcomes (Farmanesh et al., 2025; Liu & Adil, 2026). Their value depends on trustworthy data, managerial ability to use insights, integration with production practices, and financing for implementation. Digital adoption without an environmental objective can increase cost and complexity without delivering measurable improvement. Accordingly, AI is located across the sensing, mobilization, implementation, and measurement stages of the proposed cycle, not positioned as a universally effective direct cause of SME performance.

Knowledge integration becomes particularly important as the technological sophistication of environmental innovation increases. Liu et al. (2026) demonstrate that artificial intelligence capability, green business strategy, and green supply-chain management can contribute to sustainable performance through the mediating roles of knowledge integration and green innovation. Nasir et al. (2026) similarly identify green innovation as a mechanism through which knowledge management contributes to sustainable performance in Malaysian SMEs. These findings reinforce the view that information technologies generate limited strategic value unless firms possess organizational routines capable of transforming dispersed information into shared knowledge, operational experimentation, and environmental innovation.

The adoption of green innovation also depends on whether SMEs develop sufficient readiness to integrate new technologies and environmental priorities into existing business systems. Indrawati et al. (2025) identify multiple determinants affecting green innovation adoption among Indonesian SMEs, illustrating that technological availability alone does not ensure organizational implementation. Zhang et al. (2020) similarly emphasize technological, organizational, and environmental readiness as critical conditions influencing successful green innovation. This readiness perspective complements the dynamic-capability argument because firms must align technological infrastructure, managerial commitment, knowledge resources, and external environmental conditions before digital tools can contribute effectively to sustainability transformation.

Green entrepreneurial orientation further extends this capability structure by encouraging SMEs to proactively identify environmentally oriented opportunities rather than merely react to compliance requirements. Guo et al. (2020) demonstrate that green entrepreneurial orientation can stimulate green innovation through supply-chain learning, while Bindeeba et al. (2026) provide meta-analytic evidence connecting green entrepreneurial orientation with green innovation, economic performance, and broader sustainable performance. Li et al. (2025) further show that the relationship between green innovation and SME performance is shaped by the interplay of innovation approach and expenditure. Together, these studies suggest that proactive environmental orientation, learning capability, and resource commitment determine whether green innovation becomes a sustained strategic process or remains a limited response to external pressure.

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Table 3. Digital–Green Evidence Matrix: Enabling Roles and Boundaries

Capability / evidence	Context / design	Enabling mechanism	Innovation link	Boundary or risk
Digitalization: Xu et al. (2023)	SME study	Regulatory sensing / information	Supports sustainable innovation	Digital readiness required
AI / IoT: Farmanesh et al. (2025)	SMEs; AI study	Analytics and monitoring	Green innovation / competitiveness	Data and investment dependence
Knowledge: Nasir et al. (2026)	Malaysia; SME study	Knowledge acquisition / sharing	Green innovation mediation	Organizational integration
Entrepreneurship: Bindeeba et al. (2026)	Meta-analytic review	Proactivity / opportunity sensing	Green innovation / economic outcomes	Cross-study comparability
Investment: Li et al. (2025)	SMEs; expenditure study	Staged resource allocation	Innovation and performance	Costs may precede returns
Environmental analytics: Zameer et al. (2022)	Firm-level study	Data and strategy alignment	Green competitive advantage	SME transfer requires testing
Adaptation: Teece (2007)	Conceptual theory	Sensing / seizing / reconfiguring	Dynamic capability logic	Not direct SME evidence
Strategy: Hart (1995)	Conceptual theory	Environmental resource advantage	Green strategic positioning	Not an effect-size estimate

Source: Author's format from litterature.

The evidence in Table 3 indicates complementarity rather than interchangeability between green and digital capabilities. Digital tools can improve information availability and implementation, while leadership, learning, and green strategic orientation determine whether the information leads to environmental changes (Xu et al., 2023; Nasir et al., 2026). Variation in technological maturity limits the transferability of AI-intensive prescriptions to microenterprises or resource-poor SMEs. The combined implication is a contingent enabling role: digital capability may accelerate several stages of the cycle, but it neither replaces green innovation nor guarantees sustainable returns.

Table 4. Theoretical Integration of the Proposed Green Capability Cycle

Theoretical lens	Core explanatory idea	Cycle location	Contribution	Interpretive limit
Dynamic capabilities (primary)	Sensing / seizing / reconfiguring	Across six stages	Explains renewal and feedback	Cycle not yet validated
Natural-resource-based view	Environmental strategic resources	Innovation and outcomes	Explains environmental value	Not a sequence model
Resource-based view	Unequal valuable resources	Mobilization / investment	Explains firm heterogeneity	Static without renewal
Stakeholder perspective	Pressure / expectations	External trigger and sensing	Explains motivation for change	Pressure alone insufficient

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Theoretical lens	Core explanatory idea	Cycle location	Contribution	Interpretive limit
Absorptive capacity	Acquire / apply knowledge	Sensing and mobilization	Connects information to action	Requires routines and learning

Table 4 formalizes the theoretical hierarchy. Dynamic capability theory is the central lens explaining iteration and resource reconfiguration (Teece, 2007), whereas the natural-resource-based view explains the environmental basis of competitive differentiation (Hart, 1995). The resource-based view accounts for unequal capability stocks (Barney, 1991); stakeholder logic identifies external triggers (Singh et al., 2022), and absorptive-capacity research clarifies the conversion of knowledge into practice (Aboelmaged & Hashem, 2019). These theoretical functions are complementary, and none individually validates the full six-stage sequence.

A staged approach is particularly relevant because SMEs rarely possess sufficient resources to transform every aspect of their environmental operations simultaneously. Saunila et al. (2018) characterize sustainability as a driver of green innovation investment and exploitation, while Tariq et al. (2017) identify multiple drivers and consequences associated with green product and process innovation. Xie et al. (2019) further differentiate green product and green process innovation and show that these forms of innovation can generate financial outcomes through distinct mechanisms. These findings imply that SMEs can pursue sustainability progressively by first identifying environmentally material problems, then selecting the innovation pathway most closely aligned with operational priorities, resource availability, and expected business value.

Organizational learning and leadership constitute the mechanisms through which such staged implementation becomes cumulative rather than episodic. Singh et al. (2020) demonstrate that green transformational leadership and green human-resource practices contribute to green innovation and environmental performance, while Le and Lei (2018) highlight the broader importance of transformational leadership and trust in stimulating knowledge-sharing processes. Bacinello et al. (2020) further show that organizational maturity influences the relationship among corporate social responsibility, sustainable innovation, and business performance. Sustainable capability development therefore requires SMEs to retain knowledge from previous environmental initiatives, disseminate successful practices, and use performance feedback to improve subsequent innovation decisions.

The green capability cycle is proposed as a six-stage theoretical extension of dynamic capability logic: sensing identifies regulatory and market signals; mobilization organizes knowledge, finance, and leadership; innovation changes products, processes, or routines; measurement records multidimensional outcomes; learning interprets success and failure; and reconfiguration reallocates resources to subsequent opportunities. This formulation separates realized outcomes from the organizational feedback that informs the next decision, a distinction less visible in static antecedent–innovation–performance models (Teece, 2007; Singh et al., 2022; Nasir et al., 2026). The stages are logically ordered but recursive: measurement may trigger renewed sensing, while financial shortages or weak knowledge-sharing may interrupt movement between stages. Figure 1 represents a literature-informed conceptual proposition, not an empirically estimated causal path.

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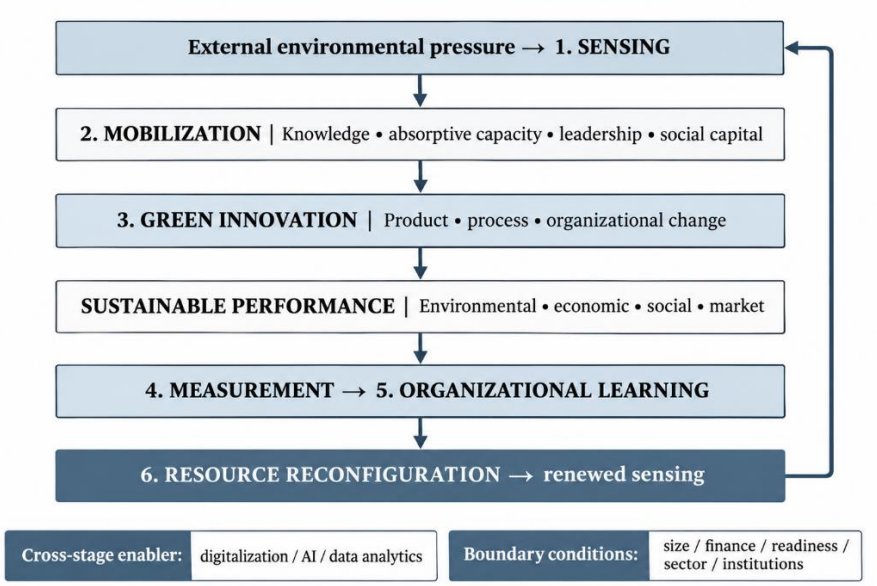


Figure 1. Literature-Informed Green Capability Cycle

Table 5 makes the boundary conditions explicit. Firm size and financing influence how much an SME can invest and absorb risk, sustainability readiness and leadership affect mobilization, and industry or regulatory differences shape relevant forms of innovation (Schrank & Kijkasiwat, 2024; Shahin et al., 2024; Yu et al., 2022). Market orientation influences whether environmental features generate customer value, while digital maturity determines the usefulness of monitoring and predictive tools (Zheng et al., 2022; Xu et al., 2023). These are theoretically motivated contextual influences; the reviewed evidence is insufficient to claim that each has been tested as a moderator of the entire cycle.

Table 5. Boundary Conditions and Expected Effects on the Capability Cycle

Boundary condition	Relevant stage	Illustrative sources	Expected influence	Interpretive caution
Firm size	Mobilization / investment	Schrank & Kijkasiwat (2024)	Resource availability varies	Not fixed size threshold
Access to finance	Innovation / commercialization	Li et al. (2025)	Constraints may delay returns	Timing not quantified
Digital maturity	Sensing / measurement	Xu et al. (2023)	Supports information use	AI not automatically beneficial
Leadership / readiness	Mobilization / learning	Majali et al. (2022)	Strategic coordination	May co-vary with firm size
Sector / regulation	Innovation choice	Yu et al. (2022); Kwak et al. (2023)	Different requirements	Context-specific outcomes
Market orientation	Value capture	Zheng et al. (2022)	Commercialization opportunity	Environmental gain ≠ profit

The third theme supports a conditional digital–green complementarity while leaving several questions unsettled. AI-enabled solutions may be more suitable for firms with mature data systems than for small operators relying on informal environmental records; general firm-level studies may likewise overstate applicability to microenterprises (Liu et al., 2026; Schrank & Kijkasiwat, 2024). The six-stage model integrates these contrasts by treating digital maturity as an enabler and

organizational resources as boundary conditions, rather than collapsing all variables into green capability. The model requires repeated-measures testing to establish sequence, feedback direction, and the circumstances in which reconfiguration strengthens or weakens subsequent performance.

Future Research Agenda

First, longitudinal panel and repeated-case studies should test whether sensing precedes mobilization and whether measurement and learning stimulate subsequent reconfiguration. Sequence should be examined using repeated organizational indicators rather than a single cross-sectional survey. An explicit rival hypothesis is that innovation and capability development may be mutually reinforcing instead of strictly ordered. Studies should document implementation costs and the lag between environmental improvement and financial performance.

Second, multi-country and multi-sector comparisons should assess whether regulation, green finance, and supply-chain requirements have different effects among micro, small, and medium-sized enterprises. Matched manufacturing–service samples could test whether product and process innovation generate different environmental and market outcomes. Research should report firm size, investment intensity, institutional conditions, digital maturity, and baseline sustainability readiness consistently. This approach would allow clearer identification of boundary conditions than a single-context design.

Third, future research should test the enabling role of AI, digital monitoring, and knowledge integration, including adverse cases involving data limitations, lock-in, and unprofitable adoption. Structural equation modeling can examine proposed mediating relationships, while longitudinal designs and process tracing are better suited to feedback and causal ordering. Comparable environmental, financial, social, and strategic indicators are needed to avoid treating perceived green reputation as equivalent to measured sustainability. These studies could validate, revise, or reject individual stages of the proposed capability cycle.

CONCLUSION

This integrative review addresses RQ1 by identifying stakeholder and regulatory pressures as external triggers and knowledge management, absorptive capacity, leadership, relational resources, and green dynamic capabilities as organizational mechanisms supporting green innovation. RQ2 is answered by distinguishing environmental, financial, social, and market outcomes: environmental benefits are more consistently associated with innovation, while near-term economic returns depend on costs, implementation, and commercialization. RQ3 identifies firm size, financial access, readiness, industry, regulation, and market conditions as plausible sources of heterogeneity rather than universally verified moderators. These conclusions reflect comparative interpretation of published sources, not causal effects estimated by the present review.

RQ4 is addressed by positioning digitalization and AI as conditional enablers of sensing, knowledge integration, implementation, and performance measurement. The main theoretical contribution is the proposed six-stage green capability cycle, which joins dynamic capability renewal to multidimensional outcome feedback and makes the roles of supporting theories explicit. Practical implications favor staged investments, evidence-based performance tracking, and resource reallocation before broad technological expansion. The evidence base was reconstructed from manuscript references rather than a documented database-search protocol, so literature coverage, effect magnitudes, and the causal order of the cycle remain unverified; future longitudinal and comparative research must test these propositions.

REFERENCES

Abbas, J., & Sağsan, M. (2019). Impact of knowledge management practices on green innovation and corporate sustainable development: A structural analysis. Journal of Cleaner Production, 229, 611-620. https://doi.org/10.1016/j.jclepro.2019.05.024

Aboelmaged, M., & Hashem, G. (2019). Absorptive capacity and green innovation adoption in SMEs: The mediating effects of sustainable organisational capabilities. Journal of Cleaner Production, 220, 853-863. https://doi.org/10.1016/j.jclepro.2019.02.150

Achmad, F., & Wiratmadja, I. I. (2025). Organizational performance and competitive advantage in SMEs: The role of green innovation and knowledge management. Journal of Open

Innovation: Technology, Market, and Complexity, 11(2), 100532. https://doi.org/10.1016/j.joitmc.2025.100532

Albort-Morant, G., Leal-Millán, A., & Cepeda-Carrión, G. (2016). The antecedents of green innovation performance: A model of learning and capabilities. Journal of Business Research, 69(11), 4912-4917. https://doi.org/10.1016/j.jbusres.2016.04.052

Al-Hanakta, R., Hossain, M. B., Pataki, L., & Dunay, A. (2023). Eco-innovation influence on business performance in Jordanian micro, small and medium enterprises operating in the food processing sector. *PLOS ONE, 18*(2), e0281664. https://doi.org/10.1371/journal.pone.0281664

Alraja, M. N., Imran, R., Khashab, B. M., & Shah, M. (2022). Technological innovation, sustainable green practices and SMEs sustainable performance in times of crisis (COVID-19 pandemic). *Information Systems Frontiers, 24*(4), 1081–1105. https://doi.org/10.1007/s10796-022-10250-z

Bacinello, E., Tontini, G., & Alberton, A. (2020). Influence of maturity on corporate social responsibility and sustainable innovation in business performance. Corporate Social Responsibility and Environmental Management, 27(2), 749-759. https://doi.org/10.1002/csr.1841

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of Management, 17(1), 99-120. https://doi.org/10.1177/014920639101700108

Bhatti, S. H., Rashid, M., Arslan, A., Tarba, S., & Liu, Y. (2023). Servitized SMEs' performance and the influences of sustainable procurement, packaging, and distribution: The mediating role of eco-innovation. *Technovation, 127*, 102831. https://doi.org/10.1016/j.technovation.2023.102831

Bindeeba, D. S., Kembabazi, O., & Tibihika, A. (2026). Green entrepreneurial orientation and its influence on green innovation, economic performance, and sustainable performance: A meta-analytic review. Future Business Journal, 12, 259. https://doi.org/10.1186/s43093-026-00964-w

Chen, Y.-S., Lai, S.-B., & Wen, C.-T. (2006). The influence of green innovation performance on corporate advantage in Taiwan. Journal of Business Ethics, 67, 331-339. https://doi.org/10.1007/s10551-006-9025-5

European Commission. (2022). Annual report on European SMEs 2021/2022: SMEs and environmental sustainability. European Commission.

Farmanesh, P., Solati Dehkordi, N., Vehbi, A., & Chavali, K. (2025). Artificial intelligence and green innovation in small and medium-sized enterprises and competitive-advantage drive toward achieving sustainable development goals. Sustainability, 17(5), 2162. https://doi.org/10.3390/su17052162

Guo, Y., Wang, L., & Chen, Y. (2020). Green entrepreneurial orientation and green innovation: The mediating effect of supply chain learning. SAGE Open, 10(1). https://doi.org/10.1177/2158244019898798

Hart, S. L. (1995). A natural-resource-based view of the firm. Academy of Management Review, 20(4), 986-1014. https://doi.org/10.5465/amr.1995.9512280033

Indrawati, H., Caska, C., Hermita, N., Sumarno, S., & Syahza, A. (2025). Green innovation adoption of SMEs in Indonesia: What factors determine it? *International Journal of Innovation Science, 17*(1), 19–37. https://doi.org/10.1108/IJIS-02-2023-0047

Ji, H., Zhou, S., Wan, J., & Lan, C. (2024). Can green innovation promote the financial performance of SMEs? Empirical evidence from China. *Corporate Social Responsibility and Environmental Management, 31*(2), 1288–1302. https://doi.org/10.1002/csr.2633

Khan, M. S., Saengon, P., Alganad, A. M. N., Chongcharoen, D., & Farrukh, M. (2020). Consumer green behaviour: An approach towards environmental sustainability. Sustainable Development, 28(5), 1168-1180. https://doi.org/10.1002/sd.2066

Khan, P. A., Johl, S. K., & Akhtar, S. (2022). Vinculum of sustainable development goal practices and firms' financial performance: A moderation role of green innovation. Journal of Risk and Financial Management, 15(3), 96. https://doi.org/10.3390/jrfm15030096

Khan, S. A. R., Sheikh, A. A., & Ahmad, Z. (2023). Developing the interconnection between green employee behavior, tax avoidance, green capability, and sustainable performance of SMEs

through corporate social responsibility. *Journal of Cleaner Production, 419*, 138236. https://doi.org/10.1016/j.jclepro.2023.138236

Kiranantawat, B., & Ahmad, S. Z. (2023). Conceptualising the relationship between green dynamic capability and SME sustainability performance: The role of green innovation, organisational creativity and agility. *International Journal of Organizational Analysis, 31*(7), 3157–3178. https://doi.org/10.1108/IJOA-04-2022-3246

Kwak, K., Kim, D., & Heo, C. (2023). Sustainable innovation in a low- and medium-tech sector: Evidence from an SME in the footwear industry. *Journal of Cleaner Production, 397*, 136399. https://doi.org/10.1016/j.jclepro.2023.136399

Le, P. B., & Lei, H. (2018). The mediating role of trust in stimulating the relationship between transformational leadership and knowledge sharing processes. Journal of Knowledge Management, 22(3), 521-537. https://doi.org/10.1108/JKM-10-2016-0463

Lestari, E. R., & Sunyoto, N. M. S. (2023). Fostering green innovation in achieving sustainable performance. *Natural Resources Forum, 47*(3), 413–434. https://doi.org/10.1111/1477-8947.12293

Li, L., Das, G., Tunio, R. A., Gopang, A. A., & Memon, S. (2025). Green innovation dynamics in SMEs: Unraveling the interplay of approach, expenditure, and performance. Sustainable Futures, 10, 100888. https://doi.org/10.1016/j.sftr.2025.100888

Liu, B., & Adil, M. (2026). Digital technologies and sustainable competitiveness: The role of AI and Internet of Things in driving green innovation and firm performance. Corporate Social Responsibility and Environmental Management. https://doi.org/10.1002/csr.70635

Liu, X., Chau, K. Y., Chang, T. C., & Moslehpour, M. (2026). Driving sustainable performance through green business strategy, artificial intelligence capability, and green supply chain management: The mediating roles of knowledge integration and green innovation. Corporate Social Responsibility and Environmental Management, 33(3), 4531-4546. https://doi.org/10.1002/csr.70397

Majali, T., Alkaraki, M., Asad, M., Aladwan, N., & Aledeinat, M. (2022). Green transformational leadership, green entrepreneurial orientation and performance of SMEs: The mediating role of green product innovation. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(4), 191. https://doi.org/10.3390/joitmc8040191

Mubeen, A., Nisar, Q. A., Patwary, A. K., Rehman, S., & Ahmad, W. (2024). Greening your business: Nexus of green dynamic capabilities, green innovation and sustainable performance. *Environment, Development and Sustainability, 26*(9), 22747–22773. https://doi.org/10.1007/s10668-023-03574-6

Nasir, A., Zakaria, N., Do, N., & Velasquez, S. (2026). The impact of knowledge management on sustainable performance with mediation effect of green innovation in Malaysian SMEs. *VINE Journal of Information and Knowledge Management Systems, 56*(4), 1149–1170. https://doi.org/10.1108/VJIKMS-02-2024-0066

Oduro, S. (2024). Eco-innovation and SMEs' sustainable performance: A meta-analysis. *European Journal of Innovation Management, 27*(9), 248–279. https://doi.org/10.1108/EJIM-11-2023-0961

OECD. (2023). OECD SME and Entrepreneurship Outlook 2023. OECD Publishing.

Omar, A., Al-Shari, A., Shah, S. H. A., Bayram, G. E., Rahman, E. Z., & Valeri, M. (2024). Green manufacturing practices and SMEs' sustainable performance: A moderated mediation mechanism of green innovation and managerial discretion. *European Business Review, 36*(4), 588–609. https://doi.org/10.1108/EBR-06-2023-0186

Ooi, S. K., Lee, C. H., & Amran, A. (2023). Assessing the influence of social capital and innovations on environmental performance of manufacturing SMEs. *Corporate Social Responsibility and Environmental Management, 30*(6), 3242–3254. https://doi.org/10.1002/csr.2550

Porter, M. E., & van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. Journal of Economic Perspectives, 9(4), 97-118. https://doi.org/10.1257/jep.9.4.97

Qiu, L., Hu, D., & Wang, Y. (2020). How do firms achieve sustainability through green innovation under external pressures of environmental regulation and market turbulence? Business Strategy and the Environment, 29(6), 2695-2714. https://doi.org/10.1002/bse.2530

Rahmani, A., Bonyadi Naeini, A., Mashayekh, J., Aboojafari, R., Daim, T., & Yalcin, H. (2024). Green innovation for a greener future: A meta-analysis of the impact on environmental performance. Journal of Cleaner Production, 460, 142547. https://doi.org/10.1016/j.jclepro.2024.142547

Rodrigues, M., & Franco, M. (2023). Green innovation in small and medium-sized enterprises (SMEs): A qualitative approach. *Sustainability, 15*(5), 4510. https://doi.org/10.3390/su15054510

Rustiarini, N. W., Bhegawati, D. A. S., & Mendra, N. P. Y. (2022). Does green innovation improve SME performance? *Economies, 10*(12), 316. https://doi.org/10.3390/economies10120316

Sahi, A. M., Jalil, N. H., Khatib, S. F. A., Alkurdi, A., & Abbas, A. F. (2026). Eco-innovation and SME competitiveness: A systematic review and conceptual framework. *Corporate Social Responsibility and Environmental Management*. https://doi.org/10.1002/csr.70674

Saunila, M., Ukko, J., & Rantala, T. (2018). Sustainability as a driver of green innovation investment and exploitation. Journal of Cleaner Production, 179, 631-641. https://doi.org/10.1016/j.jclepro.2017.11.211

Schrank, J., & Kijkasiwat, P. (2024). Impacts of green innovation on small and medium enterprises' performance: The role of sustainability readiness and firm size. Business Strategy & Development, 7(3), e407. https://doi.org/10.1002/bsd2.407

Setyaningrum, R. P., Kholid, M. N., & Susilo, P. (2023). Sustainable SMEs performance and green competitive advantage: The role of green creativity, business independence and green IT empowerment. *Sustainability, 15*(15), 12096. https://doi.org/10.3390/su151512096

Shahin, V., Alimohammadlou, M., & Abbasi, A. (2024). Identifying and prioritizing the barriers to green innovation in SMEs and the strategies to counteract the barriers: An interval-valued intuitionistic fuzzy approach. *Technological Forecasting and Social Change, 204*, 123408. https://doi.org/10.1016/j.techfore.2024.123408

Sikandar, H., Kohar, U. H. A., Sanda, G., Salman, A., Cilan, T., Shabbir, M. S., & Ramos-Meza, C. S. (2024). Eco-innovation in small and medium enterprises (SMEs): A systematic literature review. *Journal of the Knowledge Economy, 15*(2), 5841–5863. https://doi.org/10.1007/s13132-023-01367-w

Simmou, W., Govindan, K., Sameer, I., Hussainey, K., & Simmou, S. (2023). Doing good to be green and live clean! Linking corporate social responsibility strategy, green innovation, and environmental performance: Evidence from Maldivian and Moroccan small and medium-sized enterprises. *Journal of Cleaner Production, 384*, 135265. https://doi.org/10.1016/j.jclepro.2022.135265

Singh, S. K., Del Giudice, M., Chiappetta Jabbour, C. J., Latan, H., & Sohal, A. S. (2022). Stakeholder pressure, green innovation, and performance in small and medium-sized enterprises: The role of green dynamic capabilities. Business Strategy and the Environment, 31(1), 500-514. https://doi.org/10.1002/bse.2906

Singh, S. K., Del Giudice, M., Chierici, R., & Graziano, D. (2020). Green innovation and environmental performance: The role of green transformational leadership and green human resource management. Technological Forecasting and Social Change, 150, 119762. https://doi.org/10.1016/j.techfore.2019.119762

Tariq, A., Badir, Y. F., Tariq, W., & Bhutta, U. S. (2017). Drivers and consequences of green product and process innovation: A systematic review, conceptual framework, and future outlook. Technology in Society, 51, 8-23. https://doi.org/10.1016/j.techsoc.2017.06.002

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of enterprise performance. Strategic Management Journal, 28(13), 1319-1350. https://doi.org/10.1002/smj.640

UNEP. (2024). Global Resources Outlook 2024: Bend the trend - pathways to a liveable planet as resource use spikes. United Nations Environment Programme.

Wasiq, M., Kamal, M., & Ali, N. (2023). Factors influencing green innovation adoption and its impact on the sustainability performance of small- and medium-sized enterprises in Saudi Arabia. *Sustainability, 15*(3), 2447. https://doi.org/10.3390/su15032447

Xie, X., Huo, J., & Zou, H. (2019). Green process innovation, green product innovation, and corporate financial performance: A content analysis method. Journal of Business Research, 101, 697-706. https://doi.org/10.1016/j.jbusres.2019.01.010

Xu, X., Jing, R., Shahzad, U., & Xiao, F. (2023). Sustainable innovation in small and medium-sized enterprises: Environmental regulations and digitalization as catalyst. *The Journal of Environment & Development, 32*(4), 413–443. https://doi.org/10.1177/10704965231211585

Yadegaridehkordi, E., Foroughi, B., Iranmanesh, M., Nilashi, M., & Ghobakhloo, M. (2023). Determinants of environmental, financial, and social sustainable performance of manufacturing SMEs in Malaysia. *Sustainable Production and Consumption, 35*, 129–140. https://doi.org/10.1016/j.spc.2022.10.026

Yu, F., Jiang, D., & Wang, T. (2022). The impact of green innovation on manufacturing small and medium enterprises corporate social responsibility fulfillment: The moderating role of regional environmental regulation. *Corporate Social Responsibility and Environmental Management, 29*(3), 712–727. https://doi.org/10.1002/csr.2231

Zameer, H., Wang, Y., Yasmeen, H., & Mubarak, S. (2022). Green innovation as a mediator in the impact of business analytics and environmental orientation on green competitive advantage. Management Decision, 60(2), 488–507. https://doi.org/10.1108/MD-01-2020-0065

Zhang, Y., Sun, J., Yang, Z., & Wang, Y. (2020). Critical success factors of green innovation: Technology, organization and environment readiness. Journal of Cleaner Production, 264, 121701. https://doi.org/10.1016/j.jclepro.2020.121701

Zheng, L., & Iatridis, K. (2022). Friends or foes? A systematic literature review and meta-analysis of the relationship between eco-innovation and firm performance. *Business Strategy and the Environment, 31*(4), 1838–1855. https://doi.org/10.1002/bse.2986

Zheng, S., Ye, X., Guan, W., Yang, Y., Li, J., & Li, B. (2022). Assessing the influence of green innovation on the market performance of small- and medium-sized enterprises. *Sustainability, 14*(20), 12977. https://doi.org/10.3390/su142012977