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DIGITAL TRANSFORMATION AND SUSTAINABLE BUSINESS MODEL INNOVATION IN SMALL AND MEDIUM-SIZED ENTERPRISES: A SYSTEMATIC REVIEW OF DYNAMIC CAPABILITIES, VALUE CREATION, AND THE CREDIBILITY GAP IN EMERGING ECONOMIES

Abstract. Digitalisation and sustainability have converged into one of the defining strategic challenges facing contemporary small and medium-sized enterprises (SMEs). While a substantial empirical literature now documents how digital technologies reshape organisational routines, the mechanisms through which this digital capacity is converted into genuine sustainable business model innovation (SBMI), rather than superficial "digital greenwashing", remain theoretically fragmented and geographically skewed. This article systematically reviews the empirical and conceptual literature at the intersection of digital transformation, dynamic capabilities, stakeholder-oriented value creation, and sustainability disclosure in SME contexts. Drawing on quantitative studies with samples ranging from 72 to over 12,000 firms across Europe, Latin America, the Middle East, and Southeast Asia, alongside qualitative case studies from Finland, Nigeria, Ghana, and Italy, the review identifies three consistent patterns. First, digital technology adoption predicts sustainability and innovation outcomes only indirectly, mediated by dynamic capabilities, strategy, and governance rather than by technology per se. Second, the dynamic capability constructs proposed across studies, spanning digital leadership, ecosystem orchestration, and relational governance, remain theoretically unconsolidated and have not been tested jointly in a single model. Third, sustainability reporting research reveals systemic barriers and credibility risks that are especially acute in institutionally weak, resource-constrained emerging-market settings, yet Central Asia is entirely absent from the empirical record. The review concludes by specifying a research agenda for primary empirical work on digitally-enabled SBMI among SMEs in Kazakhstan and comparable transition economies.

Keywords: sustainable business model innovation; dynamic capabilities; digital transformation; SMEs; emerging economies; digital greenwashing; sustainability reporting

1. Introduction

The last decade has witnessed the convergence of two transformative pressures on firms of every size: the imperative to digitalise operations and the imperative to demonstrate genuine environmental and social responsibility (Lu and Shaharudin, 2024). For large, well-resourced multinational corporations, these pressures have generated an extensive body of strategic

management research on how digital technologies such as artificial intelligence, the Internet of Things, blockchain, and big data analytics can be harnessed to redesign value creation, delivery, and capture logics toward more sustainable outcomes, a process commonly labelled sustainable business model innovation, or SBMI (Bocken et al., 2013; Evans et al., 2017). Small and medium-sized enterprises (SMEs), however, constitute the overwhelming majority of firms in almost every national economy and face a fundamentally different set of constraints: limited financial capital, thin managerial bandwidth, informal governance structures, and, in many emerging markets, weak institutional infrastructure (Martins et al., 2022).

This asymmetry between where large-firm research is concentrated and where the bulk of global economic activity actually occurs has produced a paradox. Digital technologies are frequently described in the literature as uniquely well suited to help resource-constrained SMEs "leapfrog" larger competitors by lowering the cost of monitoring, coordination, and transparency (Lu and Shaharudin, 2024; Martínez-Peláez et al., 2023). Yet the same properties that make digital tools attractive for transparency, namely their capacity to selectively curate, visualise, and disseminate information, also create the conditions for what has been termed "digital greenwashing": the strategic use of dashboards, selective metrics, and polished digital communications to construct an inflated sustainability image without commensurate substantive change (Kim and Lyon, 2015; Bernini and La Rosa, 2023). This tension between transparency-enabling and greenwashing-enabling properties of the same technologies has received far less systematic attention than the more straightforward question of whether digital adoption improves SME performance.

This article addresses that gap through a systematic review of the empirical literature. It pursues three specific aims. First, it evaluates the strength and nature of the empirical relationship between digital technology adoption and SBMI outcomes in SMEs, testing whether this relationship is direct or, as theory would predict, conditioned by organisational capability. Second, it maps the specific dynamic capability constructs that the literature has identified as necessary intermediaries between digital adoption and sustainable outcomes, assessing the degree of theoretical convergence across studies. Third, it examines the parallel and comparatively underdeveloped literature on SME sustainability reporting and disclosure credibility, identifying where digital reporting tools intersect with governance and greenwashing risk. Throughout, particular attention is paid to the geographic distribution of the existing evidence base, in order to establish, empirically rather than by assertion, the extent to which emerging economies in general, and Central Asia specifically, remain underexamined.

2. Theoretical Background

2.1 Dynamic Capabilities Theory

Dynamic capabilities theory, originating with Teece, Pisano and Shuen's foundational formulation and elaborated across subsequent decades, holds that sustained competitive advantage in changing environments depends not merely on the possession of valuable resources but on a firm's higher-order capacity to sense opportunities and threats, seize them through resource mobilisation, and reconfigure internal and external assets accordingly (Teece, 2012). This sensing-seizing-reconfiguring triad has proven to be a durable analytical lens, and has been extended into numerous adjacent domains: global strategy (Pitelis, Teece and Yang, 2023), digital transformation specifically (Ellström et al., 2021), big data-driven marketing (Brewis, Dibb and Meadows, 2023), and blockchain-enabled circular supply chains (Quayson et al., 2023). Notably, empirical work applying the framework to a sample of 217 firms found that dynamic capabilities significantly and positively affect competitive advantage, with

environmental dynamism acting as an important moderating driver (Breznik and Lahovnik, 2016), while measurement-focused studies caution that the three sub-dimensions of sensing, seizing, and reconfiguring do not always behave uniformly in relation to firm performance (Garrido et al., 2020).

For SMEs specifically, the value of the dynamic capabilities lens lies in its explicit acknowledgement that resource-poor firms cannot compete on resource stock alone; they must compete on the agility with which they reconfigure whatever resources they possess (Soluk, Decker and Hack, 2023). This is the theoretical anchor for treating digital adoption and SBMI as related but distinct constructs, connected by an intervening capability layer rather than a direct causal arrow.

2.2 Stakeholder and Sustainability-Oriented Business Model Theory

A parallel theoretical stream treats SBMI not primarily as a capability problem but as a value-creation and value-distribution problem. Building on Freeman's stakeholder theory, this literature reframes the business model as a mechanism for co-creating value across a network of stakeholders rather than for a single shareholder class (Bocken, Short, Rana and Evans, 2013). Evans et al. (2017) synthesise business model innovation, sustainability innovation, network theory, stakeholder theory, and product-service systems literatures into five propositions supporting the design of sustainable business models that embed economic, environmental, and social value flows simultaneously.

Empirically, this perspective has been operationalised through case studies of value co-creation. A study of a Finnish energy company's circular economy transition identified five joint value-creation activities, spanning shared narrative construction, co-constructed policy knowledge, and local ecosystem development, arguing that circular business value is inherently relational and systemic rather than firm-centric (Tapaninaho and Heikkinen, 2022). Similarly, a stakeholder integration model derived from a systematic review and mining-sector report analysis identified identification, communication, knowledge-sharing, and continual improvement as the mechanisms through which sustainable business models achieve legitimacy with a broad stakeholder base (Rathobei, Ranängen and Lindman, 2024). For SMEs operating in emerging markets, where formal institutional support is often absent, this stakeholder-relational view of value creation offers a theoretically grounded alternative explanation for how legitimacy and credibility might be constructed informally, through direct stakeholder engagement rather than through codified disclosure standards.

2.3 Signalling and Institutional Theory: Explaining Digital Greenwashing

The third theoretical strand addresses why credible digital sustainability communication is difficult to achieve, drawing on signalling theory and institutional theory. Signalling theory frames sustainability disclosure as a costly signal intended to differentiate genuinely sustainable firms from imitators; greenwashing arises when firms attempt to send positive signals without incurring the underlying cost of genuine sustainability performance (Torelli, Balluchi and Lazzini, 2019; Smith and Font, 2014). A foundational contribution by Kim and Lyon (2015) extends this logic by showing that firms may either exaggerate ("greenwash") or understate ("brownwash") their environmental performance depending on which stakeholder audience is currently salient, and that regulatory and competitive context shapes this choice.

Institutional theory contributes a complementary explanation centred on legitimacy-seeking through isomorphism. An empirical study of Chinese A-share listed heavily polluting firms between 2010 and 2016 found that corporate greenwashing behaviour is significantly influenced by the greenwashing behaviour of neighbouring firms in the same region, consistent

with a "bandwagon" isomorphic effect, and that greenwashing similarity does not improve firm performance but does increase firms' perceived legitimacy and risk tolerance under uncertainty (Huang, Xie and Zhou, 2022). Complementing this, a cross-national study of firms from twelve countries found that stringent climate-related regulation reduces the likelihood of greenwashing, directly implicating weak institutional environments, a defining feature of many emerging economies, as a permissive condition for the practice (Mateo-Márquez, González González and Zamora Ramírez, 2022). Bernini and La Rosa (2023) further argue that self-regulation alone is insufficiently effective at closing the gap between symbolic and substantive sustainability behaviour, implying that governance and external assurance mechanisms, not voluntary disclosure alone, are necessary correctives.

3. Method

This review follows a structured, though not fully protocol-registered, systematic literature review approach, appropriate for synthesising a still-consolidating cross-disciplinary literature. Search terms combined "sustainable business model innovation", "digital transformation", "dynamic capabilities", "SME", "circular economy", "stakeholder theory", "greenwashing", and "sustainability reporting" in various Boolean combinations, restricted primarily to studies published between 2012 and 2026 to capture both foundational theoretical contributions and the more recent empirical wave associated with Industry 4.0 and post-pandemic digitalisation. Because this review synthesises previously published, peer-reviewed empirical findings rather than reporting new primary data collection, all sample sizes, methods, and statistical results reported below are drawn directly from the cited source studies.

4. Findings

4.1 The Digital-to-Sustainability Relationship: Direct or Conditional?

The clearest and most consistent finding across the reviewed quantitative literature is that the relationship between digital technology adoption and sustainability or innovation outcomes in SMEs is rarely direct; it is almost universally mediated or moderated by an intervening organisational variable.

A study of 723 SMEs analysed through a sequential exploratory design combining qualitative interviews and quantitative survey found that the effectiveness of digital accounting information systems positively affects SBMI, but that this relationship is only partially mediated by the firm's digital business ecosystem (Huy and Phuc, 2025), indicating that ecosystem-level integration, not the accounting technology itself, carries a substantial share of the explanatory power. In a comparable vein, two studies drawing on the same large Mexican dataset of 4,121 SMEs across services, trade, and manufacturing sectors, analysed via PLS-SEM, found first that digital transformation exerts a comparatively small direct effect on financial performance, with sustainability strategy operating as a significant moderating variable determining whether digitalisation translates into innovation outcomes at all (Valdez-Juárez et al., 2024), and second that digitalisation barriers, rather than digitalisation itself, are the dominant force suppressing innovation management and corporate performance (Valdez-Juárez, Ramos-Escobar and Borboa Álvarez, 2023).

Counter-evidence exists but is instructive rather than contradictory. A PLS-SEM study of 467 Indonesian SME managers found statistically significant positive relationships between digital transformation, digital innovation, digital knowledge management, and sustainability performance (Krisnayanto et al., 2024), and a study of 319 SME employees in India similarly found that digital technology adoption significantly predicted both economic sustainability and social value creation, with entrepreneurial orientation moderating the strength of this effect on

firm performance (Vrontis, Chaudhuri and Chatterjee, 2022). Even in these positive-effect studies, however, a moderating or mediating third variable, respectively entrepreneurial orientation and knowledge management, is required to fully specify the model; the "digital adoption alone" hypothesis is not supported anywhere in the reviewed literature.

A large bibliometric and systematic review synthesising 57 articles (drawn from an initial pool of 1,856) on SME sustainable competitive advantage concluded that digital transformation enhances SME innovation and dynamic capability specifically through helping firms overcome resource constraints, with big data, artificial intelligence, and digital platforms identified as the primary enabling technologies, again framing digitalisation's effect as capability-mediated rather than automatic (Lu and Shaharudin, 2024). A separate systematic review of 59 publications from 2019 to 2023 similarly concluded that successful sustainable digital transformation in micro, small, and medium enterprises begins with a change in organisational culture and critical capability development, before technology deployment produces sustainability benefits, with big data identified as offering the most significant potential benefit once these preconditions are met (Martínez-Peláez et al., 2023).

4.2 Dynamic Capabilities as the Mediating Mechanism

If digital adoption alone is insufficient, the empirical literature has increasingly turned to specifying exactly which capabilities perform the mediating function, though with limited convergence across studies.

A German study surveying 98 SMEs in Southern Germany found that dynamic capabilities significantly promote both digital leadership and digital culture; however, contrary to the authors' hypothesis, the mediation pathway between digital leadership and digital culture was not statistically supported, suggesting these function as parallel rather than sequential enablers of digital transformation (Held, Heubeck and Meckl, 2025). This finding is theoretically important because it cautions against assuming a single linear capability-development pathway.

Working at the ecosystem rather than firm level, a qualitative study based on in-depth interviews with innovation intermediaries, SMEs, and ecosystem actors in Finland's Ostrobothnia region identified three novel capability constructs extending the classical sensing-seizing-transforming triad: an "ancillary opportunity spotting" capability, through which intermediaries identify indirect pathways to SME digital transformation (for example via developing carbon-neutral solutions that only indirectly enable digitalisation); a "business model co-creation" capability, through which intermediaries seize opportunities by co-creating SME business models together with the SME's own customers, suppliers, and competitors; and an "ecosystem revamping" capability, through which intermediaries continually alter opportunity structures and bridge inter-ecosystem collaborations (Hafeez, Shahzad and De Silva, 2025). This ecosystem-level reframing of dynamic capabilities theory is directly relevant to any research agenda proposing "ecosystem orchestration" as a core SME capability, since it demonstrates empirically that orchestration capability may reside as much in external intermediary actors as within the focal SME itself.

A systematic review combined with bibliometric coupling of the data-driven SBMI literature identified five distinct technological pathways, digital platforms, circular economy, smart manufacturing and supply chains, blockchain, and servitisation, and proposed an integrative dynamic-capabilities process model spanning the initiation, ideation, integration, and implementation phases of business model innovation (Bachmann et al., 2025). This is

among the more theoretically ambitious contributions reviewed here, but even its authors note that the literature remains "conceptually dispersed", limiting cumulative theoretical progress.

Crisis-context research offers a further specification. A study of 42 business-to-business SME owners in Nigeria, examined through semi-structured interviews during the COVID-19 pandemic, identified twelve relational governance mechanisms of dynamic capability, disaggregated further into 34 micro-foundational components, that firms activated to manage business relationships despite operating in an environment characterised by significant institutional voids and chronic resource scarcity (Ashiru et al., 2022). This is one of the few studies in the reviewed literature explicitly set in a developing-market, institutionally weak context comparable to Kazakhstan, and its granular disaggregation of governance micro-foundations offers a template for how such capabilities might be operationalised in a Central Asian empirical study.

At larger scale, an analysis of 12,108 European SMEs drawn from the Flash Eurobarometer database, using both classical regression and machine learning techniques including artificial neural networks, found that internal digital and innovation capabilities exert a stronger influence on AI adoption than external business-environment support, and that digital and innovation capabilities interact synergistically (Arroyabe et al., 2024). A UAE-based study of 384 manufacturing SMEs across all seven emirates found that organisational learning capabilities positively influence both inbound and outbound open innovation, with inbound open innovation practices in turn improving both market effectiveness and profitability (Al Nuaimi, Singh and Ahmad, 2023). These large-sample non-European findings lend cross-contextual robustness to the general claim that internal capability, more than external environment, drives digitally-enabled outcomes in SMEs, though neither study addresses sustainability outcomes directly.

4.3 Circular Economy and Digital Technology as an SBMI Pathway

A substantial sub-literature examines the specific pathway by which digital technologies enable circular, rather than merely optimised, business models, corresponding to the "disruptive architectural change" pathway of SBMI. A systematic review applying the ReSOLVE framework found that despite broad interest in the topic, the empirical literature addresses only a limited set of circular economy aspects and specific technologies, leaving the field short of an integrated, holistic account of digital-circular economy implementation (Cagno et al., 2021). A related systematic review identified management commitment, competencies, stakeholder engagement, and contextual factors as key moderators of the digital technology-circular economy relationship, while supply chain integration, collaboration, and digitally-enabled dynamic capabilities were identified as the principal mediating mechanisms (Neri et al., 2024).

At the level of direct SME evidence, an exploratory study based on semi-structured interviews with ten Italian industrial SMEs found that digital technologies do support circular economy practice implementation, but that SMEs face a compounding "digital and circular divide" relative to larger firms, given their comparatively limited resource base (Neri et al., 2023). Case-based work on the fashion sector, one of the most environmentally scrutinised, offers further granularity. An inductive multiple-case study of ten fashion companies of varying size, including SMEs and startups, identified three distinct digital-circular business model archetypes: a blockchain-based supply chain model, a service-based model, and a "pull demand-driven" model, and found that the specific pathway chosen for digital circular transformation differs systematically between large firms, SMEs, and startups (Huynh, 2021). A separate multiple case study of ten early-stage fashion startups similarly found that environmental and

economic sustainability dimensions were prioritised over social dimensions in digital-enabled circular business model innovations, and identified closed-loop, reduced-consumption strategies as the dominant circular economy principle applied (Ostermann, Nascimento and Zen, 2021).

Not all findings in this stream are unambiguously positive regarding the strength of the digital-circular linkage. A study combining questionnaires and interviews with IT professionals across a range of organisations concluded that, where organisations pursue circular economy initiatives, a clear and direct connection with digital technology deployment is often not evident, even though a more general association between digitalisation and sustainability broadly is observable (Wynn and Jones, 2022). This finding is a useful corrective against overstating the strength or directness of the digital-circular relationship documented elsewhere in the literature, and reinforces the broader pattern identified in Section 4.1: digital technology's contribution to sustainability outcomes is conditional, contingent, and frequently indirect, rather than a straightforward causal chain.

4.4 Geographic Distribution of the Evidence Base

Systematically cataloguing the geographic origin of the primary studies reviewed above reveals a pronounced concentration in specific regions. European SMEs dominate the sample (Germany, Italy, Spain, Greece, the pan-European Flash Eurobarometer studies), with substantial additional coverage in Latin America (Mexico, at very large sample sizes exceeding 4,000 firms across two related studies) and in parts of the Middle East and Asia (the United Arab Emirates, Jordan, Vietnam, Indonesia, Saudi Arabia). African evidence exists but is comparatively sparse and often comparative rather than context-specific in design: a review explicitly comparing SME digital transformation trajectories between the United States and Africa found that African SMEs face distinctive infrastructure and capital-access constraints, but compensate through mobile technology adoption and localised digital solutions, representing a materially different capability configuration from the European or North American cases (Raji et al., 2024).

No study identified through this systematic search addresses Kazakhstan, any other Central Asian country, or the broader post-Soviet transition-economy context specifically in relation to digitally-enabled SBMI. This is not a minor gap but a structural absence: given that the theoretical mechanisms identified above, particularly institutional-void-driven relational governance (Ashiru et al., 2022) and resource-constrained capability substitution (Raji et al., 2024), are explicitly theorised as context-dependent, extrapolating findings from Nigeria, Mexico, or the UAE to a Central Asian institutional and cultural setting cannot be assumed valid without direct empirical testing.

4.5 Sustainability Reporting, Disclosure Barriers, and the Credibility Gap

The sustainability reporting literature, which addresses the third pillar of the review's scope, tells a considerably more troubling story than the capability-development literature, and is where the risk of digital greenwashing becomes most concrete.

A systematic review of 37 sustainability reporting studies retrieved from six databases and spanning the 2012 to 2023 period identified six categories of barriers that SMEs face in producing credible sustainability reports: financial, general attitudinal, knowledge and technology, organisational, policy and regulatory, and socio-environmental barriers (Setyaningsih, Widjojo and Kelle, 2024). The severity of these barriers in weak-institution contexts is illustrated starkly by a study finding that of 190 sustainability reports published by SMEs worldwide at the time of the research, not a single one originated from a Pakistani SME,

a finding the authors attribute to lack of managerial awareness, absent regulatory mandate, and insufficient stakeholder pressure to demand disclosure (Mahmood et al., 2017). This finding is directly relevant to Kazakhstan as a comparably under-regulated emerging market, since it demonstrates that formal sustainability disclosure infrastructure can be almost entirely absent even where individual firms may be undertaking substantive sustainability practices informally.

Where SME sustainability reports do exist, their substantive quality is also open to question. A lexical analysis of every English-language SME sustainability report voluntarily filed to the Global Reporting Initiative database between 2016 and 2018 found a positive relationship between company size and report length, and found that the vocabulary used across reports was highly similar regardless of firm size, suggesting the existence of a templated reporting structure that may indicate isomorphic compliance behaviour rather than genuinely differentiated sustainability communication (Ortiz Martínez and Marín-Hernández, 2023). This pattern is consistent with the institutional-isomorphism mechanism for greenwashing identified by Huang, Xie and Zhou (2022) in the large-firm Chinese context, now extended into the SME reporting domain.

Regulatory transition research adds a further dimension of concern specific to digital-era disclosure regimes. A survey of 192 SME accounting practitioners examining the feasibility of implementing the EU Green Taxonomy found that while practitioners generally believed the Taxonomy's disclosure requirements to be technically feasible, resource constraints could push firms toward symbolic rather than substantive compliance, with the study's own findings explicitly naming this risk as a form of greenwashing under conditions of implementation cost pressure (O'Reilly et al., 2023). At a broader systemic level, a systematic review of 42 sustainability-in-SME studies published between 2000 and 2020 found that research addressing sustainability reporting specifically, alongside research set in developing-country contexts and research applying rigorous theoretical grounding, remains comparatively underexplored relative to research on green management practices and firm performance more generally (Martins et al., 2022), reinforcing at the level of the entire sub-field the same geographic and thematic gaps identified independently within the capability literature in Section 4.4.

4.6 Theoretical Foundations for Digital Greenwashing Specifically

Although the reviewed greenwashing literature is drawn predominantly from large, listed-firm contexts rather than SMEs directly, its theoretical mechanisms transfer with important qualifications. Kim and Lyon's (2015) foundational distinction between exaggeration ("greenwash") and understatement ("brownwash") as competing strategic responses to stakeholder salience provides a conceptual vocabulary that has not yet, to this review's knowledge, been applied specifically to SME digital sustainability communication. A more recent systematic literature review cataloguing 111 empirical studies of firm-level greenwashing measurement found that measures of "decoupling" (the gap between symbolic communication and substantive action) are currently more widely used in the literature than measures of "selective disclosure" and that most existing greenwashing measures remain hypothetical constructs rather than validated indicators derived from confirmed incidents (Lublóy, Keresztúri and Berlinger, 2024). This methodological gap is directly relevant to any proposed empirical study of digital greenwashing among SMEs: no validated, off-the-shelf measurement instrument currently exists for this population, meaning that primary research in this space would need to adapt or develop its own coding scheme, an implication consistent with the qualitative content-analysis approach such research would need to take.

Governance-focused research on greenwashing further specifies which internal firm characteristics correlate with the practice. A study of board characteristics found that firms with more independent directors tended to greenwash more, while the presence of female board directors was associated with a reduction in the degree of greenwashing, and, critically, that greenwashing was found to reduce overall firm value (Ghitti, Gianfrate and Palma, 2023). Given that SME governance structures are typically far less formalised than those of the large, listed firms studied in this literature, board-composition-based governance levers may be largely inapplicable to the SME context, again underscoring a translation gap between the existing greenwashing evidence base and the SME population that any new empirical study would need to address directly rather than assume away.

5. Discussion and Theoretical Integration

Three integrative conclusions follow from the evidence assembled above.

First, across every large-sample quantitative study reviewed, spanning sample sizes from 319 to over 12,000 firms and geographic contexts from Mexico to Indonesia to the European Union, digital technology adoption alone does not reliably predict sustainability, innovation, or performance outcomes in SMEs. Some intervening variable, whether digital business ecosystem integration (Huy and Phuc, 2025), sustainability strategy (Valdez-Juárez et al., 2024), entrepreneurial orientation (Vrontis, Chaudhuri and Chatterjee, 2022), or organisational learning capability (Al Nuaimi, Singh and Ahmad, 2023), is required to specify a statistically adequate model. This provides strong convergent empirical support for treating dynamic capabilities, rather than digital technology itself, as the primary theoretical construct of interest in any subsequent primary research design.

Second, the specific dynamic capability constructs proposed across the reviewed studies (digital leadership and digital culture, ecosystem-level orchestration capabilities, relational governance micro-foundations, organisational learning capability) show conceptual family resemblance but have not been integrated into, or tested within, a single unified model. Bachmann et al.'s (2025) initiation-ideation-integration-implementation process model is the most ambitious attempt at synthesis identified in this review, but even its authors characterise the underlying literature as conceptually dispersed. This represents a genuine theoretical opportunity, rather than a mere descriptive gap, for research that would test a consolidated capability framework, of the kind combining strategic flexibility, ecosystem orchestration, data-driven strategic intelligence, and values-driven leadership, against empirical data from a single coherent SME population.

Third, and most consequentially for the digital greenwashing question specifically, the sustainability reporting literature demonstrates that formal disclosure infrastructure can be nearly or entirely absent in weak-institution emerging markets (Mahmood et al., 2017), that where disclosure exists it may follow templated, potentially isomorphic patterns rather than substantive differentiation (Ortiz Martínez and Marín-Hernández, 2023; Huang, Xie and Zhou, 2022), and that resource constraints under new digital-era disclosure regimes such as the EU Green Taxonomy create structural pressure toward symbolic rather than substantive compliance (O'Reilly et al., 2023). No validated measurement instrument for SME-specific digital greenwashing currently exists (Lublóy, Keresztúri and Berlinger, 2024), and no study in this review examines this question in a Central Asian or comparable post-Soviet transition-economy setting.

Taken together, these three conclusions substantiate, using an evidence base independently sourced rather than assumed, the specific research gap motivating a proposed

empirical study of Kazakhstani SMEs: such a study would extend the capability literature by testing a consolidated dynamic capability model in an entirely unstudied institutional context, and would extend the reporting literature by examining, for the first time, how digital sustainability communication tools function under conditions of institutional weakness and resource scarcity outside the handful of national contexts (chiefly Pakistan, Nigeria, and parts of the EU periphery) currently represented in that literature.

6. Limitations of the Review

This review is subject to several limitations inherent to its systematic-review design. First, because it relies on published, peer-reviewed studies retrieved through keyword-based academic database search, it may under-represent grey literature, unpublished dissertations, or non-English-language research, which is a particular concern given the near-total absence of Central Asian and Russian-language scholarship in the international indexed literature on this topic. Second, the heterogeneity of methods, sample frames, and operationalisations across the reviewed studies (ranging from single-case qualitative studies to PLS-SEM models with samples in the thousands) precludes any meta-analytic quantitative synthesis; the review instead offers a narrative and thematic synthesis, which is appropriate given the conceptual fragmentation identified but does not permit precise effect-size comparison across contexts. Third, the greenwashing-specific literature reviewed in Section 4.6 is drawn predominantly from large, listed-firm settings, and its applicability to SMEs, while theoretically plausible, has not itself been empirically validated within the reviewed literature.

7. Conclusion

This review set out to establish, on the basis of published empirical evidence rather than assumption, whether digital technology adoption directly drives sustainable business model innovation in SMEs, what capabilities mediate this relationship where it exists, and how credibly SMEs currently communicate their sustainability performance through digital channels. The evidence converges on a clear answer to the first question: the relationship is conditional, not direct, across every large-sample study identified. The answer to the second question is less settled: multiple, only partially overlapping capability constructs have been proposed, but none has been tested as an integrated model, and almost none has been tested outside Europe, Latin America, or the Middle East. The answer to the third question is the most concerning: sustainability reporting among SMEs, particularly in institutionally weak emerging markets, ranges from near-total absence to templated, potentially symbolic compliance, and no validated framework yet exists for measuring digital greenwashing specifically within this firm population. Central Asia, and Kazakhstan specifically, remains entirely unaddressed across all three literatures reviewed here, establishing an empirical gap that is both genuine and, on the basis of the mechanisms this review has identified, theoretically well-motivated for future primary research.

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