The Adoption of Green Knowledge Management in Startups: A Comparative Landscape

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Abstract: In the context of the global twin transition towards digitalisation and sustainability, startups increasingly rely on Green Knowledge Management (GKM) to integrate environmental objectives into their core operations. Although GKM is widely recognised as a relevant enabler of sustainability-oriented entrepreneurship, the existing academic literature remains fragmented. It is often limited to single-country empirical settings and frequently treats GKM as a monolithic construct rather than a complex set of distinct organisational routines. This study addresses this critical gap by providing a comparative analysis of GKM adoption between startups operating in China and Europe. Grounded in Institutional Theory and the Dynamic Capabilities View, the study conceptualises GKM as a multidimensional construct comprising five sub-dimensions: green knowledge acquisition, storage, sharing, application, and creation. To examine whether these dimensions exhibit comparable patterns across the two distinct regions, the study utilises a cross-sectional survey of 679 startups, comprising 302 firms in China and 377 in Europe, employing measurement invariance assessment to ensure robust cross-group comparability. The findings indicate statistically significant differences across all five sub-dimensions, with Chinese startups reporting consistently higher average maturity scores than their European counterparts. Crucially, these results should not be interpreted as universal performance hierarchies. Rather, they highlight region-specific baseline profiles that may reflect differences in institutional environments, support structures, and entrepreneurial ecosystems. While the observed pattern is consistent across all knowledge dimensions, the study acknowledges the descriptive nature of these capability gaps without claiming strict causal identification of the underlying drivers. This study contributes by establishing an initial comparative benchmark for multidimensional GKM across contrasting institutional contexts. Furthermore, it provides an empirical foundation for future work to investigate the mechanisms linking institutional pressures and GKM development using advanced structural modelling. From a practical perspective, the findings suggest that sustainability support for startups should be tailored to regional conditions and to the specific knowledge processes that require strengthening.

Keywords: Green knowledge management, Sustainable entrepreneurship, Startups, Comparative analysis, Institutional theory, Dynamic capabilities

1. Introduction

In the contemporary global economy, the dual imperatives of digitalisation and sustainability, often referred to as the "twin transition", have fundamentally reshaped the competitive landscape. Startups, characterised by their agility and innovative potential, are increasingly recognised as pivotal actors in driving this technological and ecological evolution (George, Merrill and Schillebeeckx, 2021; Lee et al., 2025). However, operating under severe resource constraints, these emerging ventures face significant challenges in integrating complex environmental objectives into their core operations. To navigate this demanding landscape, startups must cultivate robust internal capabilities to capture, process, and deploy environmentally relevant information. This imperative has been further intensified by the rapid diffusion of Artificial Intelligence (AI), which is fundamentally transforming how organisations acquire, store, and apply knowledge at scale, particularly in the environmental domain (Cai et al., 2025; Genty et al., 2026). Consequently, Green Knowledge Management (GKM) has emerged as a critical strategic asset that enables organisations to translate environmental awareness into tangible sustainable performance (Ulhaq et al., 2024; Fadillah, Hadijah and Gunawan, 2025).

While the theoretical importance of knowledge management (KM) in driving corporate sustainability is widely acknowledged, the existing literature exhibits notable limitations. A substantial body of research has investigated traditional KM processes, often highlighting specific routines such as knowledge acquisition, sharing, and application as essential antecedents to green innovation and sustainable performance (Nasir et al., 2024; Nguyen et al., 2025). Building on this foundation, recent scholarship has increasingly shifted its focus toward the specialised domain of GKM (Khan, Mehmood and Kwan, 2024). Notably, the emergence of AI-powered tools, such as large language models and predictive analytics, has begun to reshape each of these knowledge routines in ways that are particularly consequential for startups (Kudryavtsev et al., 2024; Kusetogullari et al., 2025). However, despite this conceptual evolution, many empirical studies still tend to treat GKM as a monolithic concept, overlooking the highly nuanced and multidimensional nature of environmental knowledge routines. To accurately capture an organisation's capability profile, it is imperative to deconstruct this broad construct. According to the foundational scale development by Yu et al. (2022), the operationalisation of GKM typically encompasses a spectrum of distinct sub-dimensions, primarily including green knowledge

acquisition, green knowledge storage, green knowledge sharing, green knowledge application, and green knowledge creation.

Furthermore, the prevailing research heavily relies on single-country empirical settings or specific industrial contexts, such as the manufacturing sectors in Pakistan (Abbas and Sağsan, 2019) or the traditional small and medium-sized enterprise (SME) sector in Malaysia (Nasir et al., 2024). Crucially, this existing body of literature is overwhelmingly concentrated on established, resource-rich corporations or mature conventional firms, leaving a notable empirical gap regarding high-growth startups. Given that startups operate with unique organisational agility yet extreme resource scarcity, GKM paradigms validated in large enterprises cannot be directly transplanted into the entrepreneurial context. This narrow geographic, sectoral, and organisational focus fails to account for the profound impact of varying institutional environments and firm life-cycle stages on entrepreneurial behaviour and capability development, an omission that contradicts the core tenets of Institutional Theory (Bruton, Ahlstrom and Li, 2010).

The institutional contexts of emerging economies and developed markets present vastly different regulatory pressures, market incentives, and cultural norms regarding sustainability (Lozano and Martínez-Ferrero, 2022). Organisations do not develop ecological capabilities in a vacuum; rather, their strategic allocation of resources is deeply conditioned by the "rules of the game" dictated by their institutional environments (North, 2012; Vatn, 2005). While the institutional landscapes of China and Europe differ in their regulatory frameworks and market incentives, how these distinct environments shape the baseline adoption of GKM in startups remains an empirical void. There is a distinct absence of rigorous cross-cultural comparative studies investigating whether startups across these regions suffer from uniform operational deficits or context-specific capability bottlenecks within their GKM sub-dimensions.

To address this research gap, this study conducts a comparative analysis of GKM adoption between startups in China and Europe. Grounded in Institutional Theory and the Dynamic Capabilities View, the paper decomposes the GKM construct into five sub-dimensions and provides an initial mapping of regional capability profiles. Employing Partial Least Squares Structural Equation Modelling (PLS-SEM) and the Measurement Invariance of Composite Models (MICOM) procedure, the study first examines cross-cultural measurement invariance and then uses independent samples t-tests to compare baseline differences across the two regions. The paper is therefore positioned as a comparative, descriptive study rather than a full causal model. Specifically, it makes three contributions: (1) it quantitatively compares multidimensional GKM profiles across two distinct institutional contexts; (2) it provides empirical support for the cross-cultural applicability of the GKM scale within this startup sample; and (3) it identifies the specific knowledge routines where regional adoption gaps are most pronounced, establishing an empirical benchmark for understanding context-dependent capability development.

The remainder of this paper is structured as follows: Section 2 outlines the theoretical background. Section 3 details the methodology, including data collection and the MICOM procedure. Section 4 presents the results of the comparative analysis. Finally, Section 5 discusses the theoretical and managerial implications, alongside concluding remarks.

2. Theoretical Background

2.1 Green Knowledge Management: From the Knowledge-based View to Dynamic Capabilities

The theoretical foundation for understanding how startups leverage environmental capabilities follows a clear evolutionary trajectory from the Resource-Based View (RBV) to the Knowledge-Based View (KBV), and ultimately to the Dynamic Capabilities View (DCV). The RBV initially posited that organisations achieve sustained competitive advantage by accumulating resources that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). Building upon this static framework, the KBV emphasised that knowledge is the most strategically significant and difficult-to-replicate resource of an organisation (Grant, 1996). However, in highly turbulent environments such as the "twin transition", possessing static knowledge is insufficient. The DCV extends these theories by emphasising a firm's ability to systematically integrate, build, and reconfigure internal and external competences to address rapidly changing environments. For green startups, which typically lack massive physical capital and established supply chains, the dynamic capability to continuously effectively manage intellectual and environmental assets becomes a primary determinant of survival.

Situated within this dynamic capabilities framework, GKM represents a specific, environmentally focused variation of traditional KM principles. Theoretically, GKM is fundamentally conceptualised as the systematic organisational process of integrating environmental considerations into the handling of knowledge assets to

foster eco-innovation and mitigate ecological footprints (Sahoo, Kumar and Upadhyay, 2023; Ulhaq et al., 2024). While early research frequently treated GKM as a singular, aggregated construct, recent methodological advancements emphasise that treating green knowledge as a monolithic entity masks the intricate operational realities of a firm. To accurately capture the true capability maturity of an organisation, scholars must decompose GKM into distinct, sequential sub-dimensions. Addressing this empirical necessity, the comprehensive scale development and validation by Yu et al. (2022) provides a robust multidimensional framework tailored to evaluate specific environmental knowledge routines. Following this validated taxonomy, this study conceptualises GKM as a multidimensional construct comprising five core routines, as summarised in Table 1.

Table 1: Dimensions of Green Knowledge Management (GKM) and their definitions

Dimension	Core meaning
Green Knowledge Acquisition (KAc)	Identifying and absorbing external environmental information, regulations, and clean technologies.
Green Knowledge Storage (KSt)	Codifying, structuring, and retaining environmental knowledge in organisational memory.
Green Knowledge Sharing (KSh)	Facilitating internal and external exchange of green practices and insights.
Green Knowledge Application (KAp)	Using stored and shared knowledge to improve operations, compliance, and strategy.
Green Knowledge Creation (KC)	Generating novel environmental solutions and green innovations.

By treating these sub-dimensions independently, this research can pinpoint the exact capability bottlenecks of startups. This shifts the academic discourse from merely asking whether a startup is "green" to identifying which specific knowledge process represents the main constraint on sustainable growth.

2.2 Institutional Context and Capability Development

While internal resource theories explain how capabilities function, Institutional Theory offers the essential theoretical lens to understand why external environments dictate the specific development pathways of these green capabilities. According to this perspective, the cultivation of green routines rarely occurs in isolation. Rather than merely acting as a passive backdrop, institutions exert powerful coercive, normative, and cognitive pressures that actively shape organisational behaviour and resource allocation (DiMaggio and Powell, 1983; Scott, 2014). Instead of purely autonomous decision-making, startups strategically adapt their KM behaviour to conform to the prevailing regulatory constraints, market incentive structures, and societal expectations of their specific geographic contexts (Bruton, Ahlstrom and Li, 2010).

The application of institutional theory is particularly critical when comparing the adoption of GKM across diverse economic regions. The European and Chinese institutional landscapes for sustainable entrepreneurship exhibit stark contrasts, generating entirely different configurations of institutional pressures. Europe is characterised by a highly mature, heavily regulated compliance environment driven by stringent top-down coercive pressures, such as the mandates embedded within the European Green Deal. Coupled with deep-rooted normative expectations regarding environmental preservation, startups in this highly institutionalised setting are often compelled to prioritise foundational compliance, rigorous documentation, and secure knowledge storage to meet strict societal and auditing standards (Scott, 2014). This environment effectively transforms foundational green routines into mandatory compliance standards rather than discretionary strategic assets. Conversely, China represents a rapidly evolving institutional environment characterised by aggressive, state-led technology incentivisation and a high-velocity market dynamic. The Chinese government heavily subsidises the digital and green sectors, creating an ecosystem where rapid expansion is rewarded. In such an environment, startups face intense mimetic and competitive isomorphic pressures to rapidly adopt widely recognised "green" signals to secure resources (DiMaggio and Powell, 1983). Chinese startups are pushed toward rapid capability deployment and active knowledge application to capture immediate market subsidies, secure state-backed funding, and establish rapid competitive positioning.

Despite these institutional disparities, there remains a gap in the empirical literature in quantitatively mapping how different environmental pressures relate to baseline maturity levels across the five GKM sub-dimensions. By bridging Institutional Theory with the DCV, this study provides a basis for comparing the GKM capability profiles of European and Chinese startups and for describing how regional contexts shape internal digital-green operations.

Based on the theoretical arguments regarding distinct institutional pressures, this study formally posits the following hypothesis:

> ***Hypothesis (H):*** *The baseline adoption levels across the five GKM sub-dimensions differ between startups in China and Europe.*

3. Methodology

3.1 Data Collection and Sample

To quantitatively assess and compare the adoption of GKM across different institutional contexts, this study employed a cross-sectional survey design. The sample comprises startups operating in two major economic regions: China and a diverse European cohort spanning France, Denmark, Germany, the United Kingdom, Italy, Poland, and Spain. Data were collected through a professional commercial survey panel service via the Qualtrics platform, with contacts sourced directly from the provider's pre-screened proprietary panels of business professionals. Target respondents were restricted to startup founders, senior executives, and managers directly involved in the strategic and operational decision-making of their respective ventures, ensuring that the informants possessed a holistic view of the firm's environmental routines.

Regarding the target population size, the commercial provider compensated respondents on a per-valid-completion basis until predetermined regional quotas were met. Consequently, the exact number of initial survey invitations distributed remains proprietary to the panel provider and is inherently unknown. Standard quality control protocols, including embedded attention checks and deduplication, were implemented proactively by the provider to ensure initial data integrity (Boas, Christenson and Glick, 2020).

While securing knowledgeable informants was crucial, maintaining structural comparability between the two regional cohorts was equally important. Consequently, the sampling criteria strictly targeted ventures that fall within the broadly recognised parameters of startups. Specifically, the selected firms across both regions are constrained by similar firm age and employee headcount boundaries, predominantly reflecting small-to-medium structural configurations. By employing this ex-ante sample restriction, the study controls for the disproportionate influence of vast resource disparities typically found between nascent ventures and large incumbent corporations. This methodological design helps ensure that the observed comparative gaps in GKM capabilities are mainly related to distinct institutional and regional contexts rather than fundamental demographic imbalances.

Given the cross-regional nature of the study, a translation and back-translation protocol was implemented. The original English measurement scales were translated into local languages (e.g., Chinese) by bilingual academic experts and subsequently back-translated into English by independent researchers to ensure semantic equivalence and cross-cultural validity. Before the full-scale distribution, a pre-test was conducted with a small pilot group of startup founders to evaluate the clarity, readability, and relevance of the questionnaire items, leading to minor refinements. Furthermore, to mitigate the risk of Common Method Bias (CMB), several procedural remedies were applied ex-ante (Podsakoff et al., 2003). To prevent response inertia and patterned answering, the presentation order of the questionnaire items was systematically randomised. Additionally, respondents were assured of strict anonymity and confidentiality, and were explicitly informed that there were no right or wrong answers, thereby minimising social desirability bias and respondent defensiveness.

After secondary data screening to eliminate any remaining incomplete responses or unengaged answering patterns, the final valid sample comprised 679 startups. This dataset includes 302 validated responses from Chinese startups and 377 validated responses from European startups. The resulting sample provides a sound empirical foundation for conducting comparative institutional analysis and offers sufficient statistical power for the present study.

3.2 Measurement Scales

To capture the multidimensional nature of organisational capabilities, this study adopted the comprehensive GKM scale developed and validated by Yu et al. (2022). The measurement instrument decomposes GKM into five distinct, interrelated sub-dimensions: Green Knowledge Acquisition (KAc, 5 items), Storage (KSt, 5 items), Sharing (KSh, 6 items), Application (KAp, 5 items), and Creation (KC, 5 items). All items were evaluated on a standard 5-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). Minor linguistic adaptations were made to align the phrasing with the specific context of green startups without altering the core theoretical meaning. The complete survey script, detailing the exact phrasing of all measurement items, is presented in Table 2.

Table 2: Measurement items for Green Knowledge Management (GKM)

Item	Wording
Green Knowledge Acquisition (KAc) — 5 items	
KAc1	We regularly acquire information about eco-friendly products or services from external stakeholders (e.g., customers, suppliers).
KAc2	We regularly acquire information about eco-friendly products or services from internal stakeholders (e.g., management, staff).
KAc3	We regularly arrange training sessions for employees to develop their knowledge of eco-friendly products or services.
KAc4	We have a well-developed information system that enables employees to access the eco-friendly information they need.
KAc5	We encourage and support our employees to acquire knowledge about eco-friendly products or services.
Green Knowledge Storage (KSt) — 5 items	
KSt1	We have sufficient information about eco-friendly products or services.
KSt2	We have an effective information system to manage information on eco-friendly products or services.
KSt3	We can easily retrieve information about specific environmental challenges from our information system.
KSt4	We have comprehensive information about our competitors and the impact of their operations on the natural environment.
KSt5	We have procedures to retain departing employees' critical knowledge within our information system.
Green Knowledge Sharing (KSh) — 6 items	
KSh1	We regularly interact internally to discuss environmental developments and share related knowledge.
KSh2	We have a well-organised system (e.g., platforms, routines, or communities) that enables us to share environmental knowledge and learn from each other.
KSh3	We have access to up-to-date equipment and collaboration tools to obtain and share environmental knowledge.
KSh4	We recognise and reward employees who share innovative ideas and information to protect the natural environment.
KSh5	We regularly share the latest environmental knowledge and market trends with employees through emails, training sessions, workshops, etc.
KSh6	We regularly share information and knowledge related to the natural environment with our customers, suppliers, and other external stakeholders.
Green Knowledge Application (KAp) — 5 items	
KAp1	We fully comply with environmental regulations in our operations.
KAp2	We ensure that the acquired knowledge is applied to develop eco-friendly products or services.
KAp3	We use the knowledge obtained from our experiences and mistakes to continuously improve our environmental performance.
KAp4	We use acquired knowledge to shape our eco-friendly business strategies.
KAp5	We are committed to the ongoing implementation and monitoring of eco-friendly initiatives.
Green Knowledge Creation (KC) — 5 items	
KC1	We use existing information to create eco-friendly products or services.
KC2	We encourage debates and discussions at all levels to generate new environmental knowledge.
KC3	We highly appreciate and reward employees who propose new ideas, knowledge, and solutions for sustainability.
KC4	We collaborate with other firms or institutions to co-create eco-friendly products or services.
KC5	We regularly evaluate new green ideas for further refinement.

Note: Items were rated on a 5-point Likert scale. Throughout the scale, "we" refers to the respondent's company.
Source: Adapted from Yu et al. (2022).

3.3 Analytical Strategy: Measurement Invariance and Mean Comparison

Before comparing the GKM adoption levels between Chinese and European startups, it is an important methodological prerequisite to establish that the measurement instrument operates identically across both

cultural groups. Comparing mean scores without establishing invariance can lead to biased conclusions, as differences might stem from diverse cultural interpretations of the survey items rather than actual capability gaps. Therefore, this study uses PLS-SEM to perform the MICOM procedure (Henseler, Ringle and Sarstedt, 2016). The MICOM procedure is a multi-step assessment that checks for configural invariance and compositional invariance. Only after establishing partial measurement invariance through the PLS-SEM algorithm can the study proceed to cross-regional comparisons.

Subsequently, independent samples t-tests were conducted using the Statistical Package for the Social Sciences (SPSS). By using the raw Likert-scale mean scores, this analytical step quantified and compared the baseline capability gaps between the two regional groups. Furthermore, Levene's test for equality of variances was incorporated to adjust the t-values and degrees of freedom, accounting for the varying sample sizes and potential heteroscedasticity between the Chinese and European datasets (Field, 2024).

4. Results

4.1 Measurement Invariance Assessment

Before conducting a cross-regional comparison of organisational capabilities, it is necessary to establish that the measurement instrument operates equivalently across both the Chinese and European startup samples. Step 1 of the MICOM procedure established configural invariance, as both regional groups were evaluated using identical indicators, data treatment, and algorithm settings within the SmartPLS environment. Subsequently, Step 2 assessed compositional invariance by examining the original correlation (c-value) between the empirical composite scores of both groups. The results of the permutation test (based on 5,000 permutations) are detailed in Table 3.

As shown in Table 3, the original correlations (c-values) for all GKM sub-dimensions are very high, ranging from 0.997 to 1.000. While the permutation p-values for Knowledge Acquisition (KAc), Knowledge Sharing (KSh), and Knowledge Application (KAp) fall below the 0.05 threshold, this statistical rejection can be attributed to the heightened sensitivity of the permutation test when applied to large datasets (N = 679). Because the c-values remain near-perfect, established methodological guidelines suggest that the composites are practically identical across the two groups. Thus, practical compositional invariance is successfully established for the present sample. This robust validation provides a reliable methodological foundation for conducting meaningful cross-regional mean comparisons while effectively mitigating the risk of substantial measurement bias.

Table 3: Results of measurement invariance of composite models (MICOM) step 2

Constructs	Original correlation (c)	5.0% Quantile	Permutation p-value	Invariance status
KAc	1.000	1.000	0.015	Practically established
KSt	1.000	0.999	0.570	Fully established
KSh	1.000	1.000	0.017	Practically established
KAp	0.997	0.999	0.000	Practically established
KC	1.000	1.000	0.090	Fully established

Having established partial measurement invariance (Step 2), the methodological prerequisite for cross-group comparison is fulfilled. This validation provides a reasonable foundation for the subsequent use of traditional parametric tests (e.g., independent samples t-tests) to compare the observed construct means, indicating that the identified differences stem primarily from actual capability gaps rather than divergent cultural interpretations of the measurement items. Nevertheless, consistent with the descriptive nature of this study, the findings should still be interpreted as regional baseline differences within this specific sample rather than universally applicable estimates.

4.2 Comparative Analysis of GKM Adoption

An initial assessment of the pooled sample (N=679) indicated moderate to high overall adoption levels across the five GKM dimensions. However, given the theoretical premise that institutional contexts shape capability development, analysing the aggregated data would obscure regional differences. Therefore, building upon the invariant measurement model, independent samples t-tests were conducted to compare the raw Likert-scale mean scores of the five GKM sub-dimensions between the two regions. As Levene's test for equality of variances was significant ($p < 0.001$) across all variables, the t-values and degrees of freedom (df) were adjusted and reported under the assumption of unequal variances. Table 4 presents the comparative statistics.

Table 4: Independent samples T-Test for GKM adoption (China vs. Europe)

Constructs	China (N = 302)	Europe (N = 377)	Mean difference	t-value	df	p-value	Cohen's d
	Mean (SD)	Mean (SD)					
KAc	4.23 (0.74)	3.42 (1.09)	0.813	11.530	661.437	< 0.001	0.855
KSt	4.24 (0.67)	3.44 (0.96)	0.797	12.684	666.133	< 0.001	0.943
KSh	4.25 (0.73)	3.40 (1.10)	0.844	11.971	656.632	< 0.001	0.886
KAp	4.27 (0.70)	3.76 (0.96)	0.507	7.954	672.205	< 0.001	0.594
KC	4.27 (0.67)	3.51 (1.06)	0.766	11.471	644.793	< 0.001	0.845

Note: t-values and degrees of freedom are reported based on equal variances not assumed. SD = Standard Deviation.

The empirical data reveals a clear and statistically significant baseline divergence. Chinese startups reported consistently high self-assessment scores across the entire GKM spectrum, with means ranging from 4.23 to 4.27 on a 5-point scale. Conversely, European startups exhibited a more conservative baseline capability profile, with average scores ranging predominantly from 3.40 to 3.76.

The independent samples t-tests confirmed that the mean differences across all five GKM dimensions are statistically significant ($p < 0.001$). Importantly, the effect size analysis (Cohen's d) supports the practical magnitude of these differences, confirming they are not merely statistical artefacts driven by the large sample size. According to standard benchmarks, the effect sizes for Knowledge Storage ($d = 0.943$), Knowledge Sharing ($d = 0.886$), Knowledge Acquisition ($d = 0.855$), and Knowledge Creation ($d = 0.845$) are large. Knowledge Application ($d = 0.594$) demonstrated a medium-to-large effect size. Together, these results indicate a substantial practical gap in capability adoption, thereby supporting Hypothesis (H) for the present dataset.

5. Discussion and Conclusions

5.1 Discussion of Findings

This study offers an initial comparative analysis of GKM adoption between Chinese and European startups. The empirical results show a statistically significant difference in baseline capability profiles, with Chinese startups reporting consistently higher scores across all five sub-dimensions. These differences suggest that GKM adoption is highly context-dependent and should be interpreted with caution, as the present study observes baseline variances rather than testing a strict causal mechanism. Importantly, these findings introduce a necessary boundary condition, challenging prior literature that implicitly approaches GKM as a universally applicable set of best practices (Abbas and Sağsan, 2019; Nasir et al., 2024). Furthermore, by applying the MICOM procedure, the study provides sample-specific evidence that the multidimensional GKM scale can be robustly used for cross-cultural comparison, laying a foundation for future predictive modelling in global contexts (Henseler, Ringle and Sarstedt, 2016; Hair et al., 2019).

To interpret these regional divergences, Institutional Theory offers a valuable lens. One plausible explanation for the higher scores among Chinese startups is the presence of a strong, state-led support environment. China has heavily incentivised the green technology and digital sectors, creating a high-velocity ecosystem characterised by intensive coercive and mimetic isomorphic pressures that incentivise startups to signal green competence in order to access public subsidies and state-backed resources (DiMaggio and Powell, 1983; Marquis and Qian, 2014; Chen et al., 2018). In such an environment, startups may experience intense mimetic and competitive isomorphic pressures to aggressively deploy green knowledge and generate eco-innovations to capture state support and market share. Consequently, founders might be driven to prioritise higher-order dimensions, which is reflected in their peak absolute scores in Knowledge Application and Creation, perceiving them as immediate competitive advantages (Khan, Mehmood and Kwan, 2024).

By contrast, the lower scores reported by European startups may reflect a vastly different, compliance-oriented regulatory landscape. In Europe, stringent environmental compliance is deeply embedded in the market fabric, driven in large part by overarching regulatory frameworks such as the European Green Deal (Lamenta and Grzybowska, 2023). In such settings, foundational green knowledge routines are often treated as absolute regulatory baselines or essential "hygiene factors" rather than unique strategic assets. This hyper-regulated environment may foster a culture of rigorous, self-critical evaluation, leading European startups to adopt a more

conservative stance when rating their foundational capabilities (Bocken and Geradts, 2020; Baumüller and Sopp, 2022).

Additionally, these findings may also be influenced by cross-cultural response styles. Research on survey methodology has consistently documented that respondents in East Asian and emerging-market contexts tend toward more extreme positive responding on Likert-type scales, while Western European respondents typically exhibit a central-tendency bias that produces more moderate self-assessments (Harzing, 2006). This interpretive caveat adds necessary contextual depth to the descriptive survey data without overstating causality, and future research employing objective performance indicators would help disentangle genuine capability gaps from measurement artefacts.

5.2 Theoretical and Managerial Implications

As an empirical analysis, this study offers initial theoretical insight into the relationship between international entrepreneurship and GKM. By executing the MICOM procedure, the research provides sample-specific evidence for the cross-cultural comparability of the multidimensional GKM scale developed by Yu et al. (2022). The findings suggest that while baseline adoption levels differ, the underlying structure of green knowledge routines remains broadly similar across the two institutional settings. This provides a basis for future, more complex modelling in later work.

From a managerial perspective, these findings caution against a "one-size-fits-all" approach to sustainable digitalisation. For European managers and investors, the data suggests a need to support startups in building stronger digital knowledge storage infrastructures, as digital tools can help manage green knowledge more efficiently (Ulhaq et al., 2024). European policymakers may also encourage founders to move from a compliance-driven mindset towards more proactive innovation. For Chinese stakeholders, the uniformly high self-assessments may indicate a need for closer examination in future research so that genuine capability development can be distinguished from overly optimistic reporting.

5.3 Limitations and Future Research

While this study provides robust comparative insights, it is subject to three main limitations. First, concerning data collection, the reliance on cross-sectional, self-reported data introduces inherent biases, although these were effectively mitigated by the MICOM procedure and ex-ante procedural remedies. Second, at the theoretical measurement level, this study did not quantitatively capture specific macro-institutional variables, such as regional compliance indices or government subsidies. Third, regarding analytical depth, the current research scope is confined to a descriptive baseline exploration of capability differences rather than testing complex causal relationships.

Building upon this baseline exploration, future research should move beyond descriptive comparisons to examine the broader structural relationships between GKM routines and firm outcomes. Specifically, subsequent studies could investigate how these distinct knowledge dimensions influence actual sustainable performance. Furthermore, there is a clear avenue to explore complex mediating mechanisms and the moderating role of digital technologies, such as AI, in translating these regional capabilities into tangible ecological and financial results.

5.4 Conclusion

In conclusion, navigating the twin transition of digitalisation and sustainability requires a contextualised understanding of organisational capabilities. By mapping the multidimensional GKM landscape of 679 startups, this preliminary study shows that regional institutional forces are associated with different patterns of how green knowledge is acquired, stored, shared, applied, and created. Recognising these comparative differences is an early step toward building more context-sensitive sustainable enterprises in the global digital economy.

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Ethics Declaration: No formal ethical approval was required. This study involved a standard, anonymous organisational-level survey of startup managers, without collecting sensitive personal data or involving vulnerable populations.

AI Declaration: AI tools were utilised solely for language refinement and proofreading. The author thoroughly reviewed all AI-assisted content and retains full responsibility for the manuscript's accuracy and originality.

References

Abbas, J. and Sağsan, M. (2019) "Impact of Knowledge Management Practices on Green Innovation and Corporate Sustainable Development: A Structural Analysis", *Journal of Cleaner Production*, Vol 229, No. 2, pp 611-620.

Barney, J. (1991) "Firm Resources and Sustained Competitive Advantage", *Journal of Management*, Vol 17, No. 1, pp 99-120.

Baumüller, J. and Sopp, K. (2022) "Double Materiality and the Shift from Non-Financial to European Sustainability Reporting: Review, Outlook and Implications", *Journal of Applied Accounting Research*, Vol 23, No. 1, pp 8-28.

Boas, T.C., Christenson, D.P. and Glick, D.M. (2020) "Recruiting Large Online Samples in the United States and India: Facebook, Mechanical Turk, and Qualtrics", *Political Science Research and Methods*, Vol 8, No. 2, pp 232-250.

Bocken, N.M.P. and Geradts, T.H.J. (2020) "Barriers and Drivers to Sustainable Business Model Innovation: Organization Design and Dynamic Capabilities", *Long Range Planning*, Vol 53, No. 4, p 101950.

Bruton, G.D., Ahlstrom, D. and Li, H.L. (2010) "Institutional Theory and Entrepreneurship: Where Are We Now and Where Do We Need to Move in the Future?", *Entrepreneurship Theory and Practice*, Vol 34, No. 3, pp 421-440.

Cai, F., Bolisani, E., Kassaneh, T.C., Kirchner, K. and Moradi, B. (2025) "How Does AI-Driven Knowledge Management Enhance Sustainability of Startups? A Conceptual Framework", *Proceedings of the 25th European Conference on Knowledge Management*, Academic Conferences and Publishing Limited.

Chen, X., Yi, N., Zhang, L. and Li, D. (2018) "Does Institutional Pressure Foster Corporate Green Innovation? Evidence from China's Top 100 Companies", *Journal of Cleaner Production*, Vol 188, pp 304-311.

DiMaggio, P.J. and Powell, W.W. (1983) "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields", *American Sociological Review*, Vol 48, No. 2, pp 147-160.

Fadillah, M.I., Hadijah, H.S. and Gunawan. (2025) "Navigating Green Knowledge Management: A Systematic Literature Review on Implementation, Challenges and Best Practices", *Journal of Information & Knowledge Management*, Preprint.

Field, A. (2024) *Discovering Statistics Using IBM SPSS Statistics* (6th ed.), SAGE Publications, London.

Genty, K.I., Kaisara, G., Atiku, S.O. and Villet, H.J. (2026) "Implementing Artificial Intelligence for Knowledge Management in Small and Medium Enterprises", in Russ, M. and Lytras, M.D. (Eds.), *AI-Driven Knowledge Management Assets, Volume 2: Strategies for the Modern Business Landscape*, Emerald Publishing.

George, G., Merrill, R.K. and Schillebeeckx, S.J.D. (2021) "Digital Sustainability and Entrepreneurship: How Digital Innovations Are Helping Tackle Climate Change and Sustainable Development", *Entrepreneurship Theory and Practice*, Vol 45, No. 5, pp 999-1027.

Grant, R.M. (1996) "Toward a Knowledge-Based Theory of the Firm", *Strategic Management Journal*, Vol 17, No. S2, pp 109-122.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019) "When to Use and How to Report the Results of PLS-SEM", *European Business Review*, Vol 31, No. 1, pp 2-24.

Harzing, A.W. (2006) "Response Styles in Cross-National Survey Research: A 26-Country Study", *International Journal of Cross Cultural Management*, Vol 6, No. 2, pp 243-266.

Henseler, J., Ringle, C.M. and Sarstedt, M. (2016) "Testing Measurement Invariance of Composites Using Partial Least Squares", *International Marketing Review*, Vol 33, No. 3, pp 405-431.

Khan, A.N., Mehmood, K. and Kwan, H.K. (2024) "Green Knowledge Management: A Key Driver of Green Technology Innovation and Sustainable Performance in the Construction Organizations", *Journal of Innovation & Knowledge*, Vol 9, No. 1, p 100455.

Kudryavtsev, D., Khan, U. and Kauttonen, J. (2024) "Transforming Knowledge Management Using Generative AI: From Theory to Practice", *Proceedings of the 16th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management*, pp 362-370.

Kusetogullari, A., Kusetogullari, H., Andersson, M. and Gorschek, T. (2025) "GenAI in Entrepreneurship: A Systematic Review of Generative Artificial Intelligence in Entrepreneurship Research: Current Issues and Future Directions", *arXiv*, Preprint.

Lee, K. et al. (2025) "Unpacking Sustainability in Start-Ups: A Systematic Review and Research Agenda", *Discover Sustainability*, Vol 6, No. 1, p 218.

Lamenta, Z.A. and Grzybowska, K. (2023) "Impact of the European Green Deal on Business Operations—Preliminary Benchmarking", *Sustainability*, Vol 15, No. 10, p 7780.

Lozano, M.B. and Martínez-Ferrero, J. (2022) "Do Emerging and Developed Countries Differ in Terms of Sustainable Performance? Analysis of Board, Ownership and Country-Level Factors", *Research in International Business and Finance*, Vol 62, No. 4, p 101688.

Marquis, C. and Qian, C. (2014) "Corporate Social Responsibility Reporting in China: Symbol or Substance?", *Organization Science*, Vol 25, No. 1, pp 127-148.

Nasir, A. et al. (2024) "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*, Preprint.

Nguyen, N.T.T., Nguyen, P.V., Vrontis, D. and Vo, N.T.T. (2025) "Enhancing Organizational Sustainable Performance Through Green Innovation: The Roles of Knowledge Application, Government Policy, and Green Market Orientation", *Journal of Knowledge Management*, Vol 29, No. 3, pp 870-890.

North, D.C. (2012) *Institutions, Institutional Change and Economic Performance*, Cambridge University Press, Cambridge.

Podsakoff, P.M. et al. (2003) "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies", *Journal of Applied Psychology*, Vol 88, No. 5, pp 879-903.

Sahoo, S., Kumar, A. and Upadhyay, A. (2023) "How Do Green Knowledge Management and Green Technology Innovation Impact Corporate Environmental Performance? Understanding the Role of Green Knowledge Acquisition", *Business Strategy and the Environment*, Vol 32, No. 1, pp 551-569.

Scott, W.R. (2014) *Institutions and Organizations: Ideas, Interests, and Identities* (4th ed.), SAGE Publications, Thousand Oaks.

Ulhaq, I., Nayak, R., George, M., Nguyen, H. and Quang, H. (2024) "Green Knowledge Management: A Bibliometric Analysis, Research Trends and Future Directions", *VINE Journal of Information and Knowledge Management Systems*, Preprint.

Vatn, A. (2005) *Institutions and the Environment*, Edward Elgar Publishing, Cheltenham.

Yu, S. et al. (2022) "Green Knowledge Management: Scale Development and Validation", *Journal of Innovation & Knowledge*, Vol 7, No. 4, p 100244.