Guest editorial: Advancing business sustainability through innovation, entrepreneurship and internationalization

The relationship between innovation, entrepreneurship, internationalization and business sustainability has moved decisively to the center of contemporary scholarly and managerial debate. These domains are no longer best understood as separate analytical silos; instead, they increasingly converge in ways that reshape organizational behavior, market expansion, territorial development and long-term competitiveness. The contributions gathered in this Special Issue of the *International Journal of Innovation Science* reflect this convergence with considerable analytical breadth and conceptual depth, advancing the view that innovation is not merely a source of technological novelty, but a systemic process shaped by institutions, incentives, capabilities and evolving sustainability pressures.

A central insight is that sustainability cannot be achieved through formal alignment or regulatory design alone. Several contributions demonstrate that the effectiveness of sustainability-oriented policies depends critically on implementation capacity, institutional coordination, behavioral adaptation and the role of intermediaries in transitions (Lobo *et al.*, 2025). For instance, evidence from environmental regulation highlights that legal harmonization does not automatically translate into operational effectiveness, as gaps in technological monitoring, stakeholder coordination and incentive structures can significantly limit outcomes (Chen *et al.*, 2018). This reinforces a broader argument running through the Special Issue: Sustainability is ultimately enacted through organizational and technological systems, not only through policy frameworks.

This translation problem is equally visible in studies of fiscal instruments. Corporate tax incentives designed to stimulate innovation and investment illustrate how policy tools can shape entrepreneurial and corporate behavior, but also how their effectiveness depends on institutional credibility and behavioral responsiveness (Walter *et al.*, 2022). Such findings underscore that policy-driven innovation is not a mechanical outcome of incentives, but a dynamic interaction between firms' strategic choices and the regulatory environments in which they operate. Within the context of business sustainability, this highlights the importance of designing instruments that are not only economically efficient but also behaviorally effective.

A second major theme concerns territorial and structural heterogeneity. Evidence from rural and emerging economy contexts demonstrates that innovation systems are deeply uneven across space and institutional settings. Spatial clustering analyses reveal that innovation capacity is not uniformly distributed, but shaped by distinct configurations of infrastructure, institutional engagement and sociodemographic conditions (Chaminade and Edquist, 2010). Such findings challenge one-size-fits-all policy approaches and instead emphasize the need for differentiated, place-sensitive innovation strategies. In a similar vein, research on technology-based entrepreneurship in low R&D environments shows that innovation outcomes depend on the interaction between internal firm capabilities and external ecosystem conditions, including research infrastructure, venture capital access and knowledge networks (Audretsch and Belitski, 2021). These results reinforce the idea that entrepreneurial performance is fundamentally relational and ecosystem-dependent.

International Journal of Innovation Science
Vol. 18 No. 4, 2026
pp. 913-920

1757-2223
DOI 10.1108/IJIS-08-2026-658

The growing interdependence between digital transformation and sustainability-oriented innovation is also relevant. Evidence from firm-level studies shows that green innovation and digital capabilities are mutually reinforcing, with digital technologies acting as enabling mechanisms that enhance the effectiveness of sustainability strategies (Yin and Yu, 2022) and circular economy practices (Gruba *et al.*, 2022). This perspective reframes digital transformation not as an independent technological shift, but as an embedded capability that shapes how firms implement and scale sustainability initiatives. At the same time, ESG-oriented innovation studies reveal that sustainability investments may generate delayed financial returns, with green innovation often acting as a mediating but initially costly mechanism in value creation processes (Chouaibi *et al.*, 2022). These findings suggest that sustainable competitiveness requires long-term strategic orientation rather than short-term financial optimization.

At the policy level, the role of behavioral and dynamic mechanisms is further illustrated through models of subsidy design and consumer preference heterogeneity. Evidence shows that innovation incentives do not operate uniformly across firms; instead, their effects vary depending on firm type, market positioning and demand conditions (Han *et al.*, 2023). This highlights the importance of policy calibration in ensuring that innovation support mechanisms generate both efficiency and equity in technological diffusion.

Methodologically, the contributions in this Special Issue reflect a broader evolution in innovation science toward greater analytical sophistication. The use of spatial clustering, structural equation modeling, mediation analysis and dynamic modeling illustrates a shift away from linear causality toward approaches capable of capturing heterogeneity, nonlinearity and contextual dependence. This methodological diversity is not merely technical; it reflects a deeper conceptual recognition that innovation systems are complex, adaptive and multilevel.

Importantly, the Special Issue also extends innovation analysis beyond high-technology sectors to include traditionally underexamined domains. Evidence from long-term sectoral studies shows how even mature industries are undergoing transformation through process innovation, automation and sustainability-driven technological upgrading. This reinforces the idea that innovation is not confined to frontier sectors but is increasingly pervasive across diverse industrial contexts, including those shaped by heritage, tradition and incremental improvement trajectories.

Finally, the macro-structural dimension of business sustainability is addressed through studies of geopolitical risk and energy market dynamics. These contributions demonstrate that external shocks and geopolitical instability significantly reshape commodity flows and risk transmission mechanisms, with direct implications for firm resilience and sustainability strategies (Caldara and Iacoviello, 2022). This broadens the analytical scope of the Special Issue by situating innovation and sustainability within a wider context of global uncertainty and systemic volatility.

The contributions in this Special Issue converge on a unifying insight: innovation is most consequential when understood as a systemic phenomenon embedded in institutional, territorial, entrepreneurial and geopolitical structures. Across contexts, the evidence consistently shows that formal policies require implementation capacity, entrepreneurial success depends on ecosystem alignment, and sustainability outcomes emerge from long-term, multilevel interactions rather than isolated interventions. In this sense, the Special Issue advances a more integrated vision of business sustainability, one that connects entrepreneurship and internationalization with the broader architectures of innovation systems, institutional governance and global change.

Innovation, sustainability and public policy

The first group of articles in this special issue examines the increasingly important intersection between innovation, sustainability and public policy. These studies demonstrate that achieving sustainable development outcomes requires more than technological advancement alone. Rather, sustainability emerges from the interaction of innovation capabilities, digital transformation, regulatory frameworks, fiscal incentives, governance structures and institutional environments. The contributions span multiple geographical contexts, including Indonesia, Portugal, the European Union and the G7 economies, offering a diverse perspective on how innovation can support economic, environmental and social objectives.

A central theme is the role of sustainability-oriented innovation in generating organizational and societal value. Engko and Rahmiati (2026) analyze ESG performance, green innovation and firm value in Indonesia, showing that ESG performance positively affects both green innovation and firm value. However, green innovation does not yield immediate financial gains and may initially reduce firm value, while still acting as a key mediating mechanism. This highlights sustainability investments as long-term strategic capabilities rather than short-term financial instruments.

Setiawan *et al.* (2026) further emphasize the enabling role of technology by examining digital technology as a mediator between green innovation and business performance in Indonesia's automotive industry. Their findings show that digital capabilities significantly strengthen the impact of green innovation on performance. By integrating the Technology–Organization–Environment framework with the resource-based view, the study demonstrates that digital transformation and environmental innovation are complementary processes that jointly drive sustainable competitiveness.

From a policy perspective, Calado *et al.* (2026) examine corporate tax incentives in Portugal as behavioral tools for innovation. Focusing on SIFIDE and RFAI, the study shows increasing concentration of fiscal benefits in innovation-driven programs. It proposes fiscal innovation as a mechanism for behavioral change guided by impact, simplicity and applicability, illustrating how tax policy can shape innovation ecosystems and support Sustainable Development Goals.

At a systemic level, Marques *et al.* (2026) explore geopolitical risk and energy commodity dynamics across G7 economies. Their results show that geopolitical shocks significantly alter the role of energy commodities, with several shifting from shock absorbers to shock transmitters after major conflicts. This highlights the interdependence between geopolitical instability, energy systems and sustainability, extending the analysis of innovation and resilience beyond firm-level dynamics.

Finally, Castro Oliveira *et al.* (2026) examine the implementation of Waste Electrical and Electronic Equipment (WEEE) legislation within the European Union through an analysis of the Portuguese case. Their findings suggest that regulatory harmonization alone is insufficient to ensure effective environmental outcomes. Despite formal compliance with European directives, Portugal continues to face challenges in meeting collection and recycling targets. The study attributes these shortcomings not only to traditional factors such as enforcement limitations and consumer behavior but also to deficiencies in technological, institutional and behavioral innovation. In particular, the authors identify weaknesses in digital monitoring systems, traceability mechanisms, stakeholder coordination and incentive structures. Their analysis underscores the importance of innovation as a critical complement to regulatory frameworks and demonstrates how policy effectiveness depends on the successful integration of innovative practices throughout implementation processes.

Taken together, the studies in this section demonstrate that sustainability challenges require integrated solutions that combine technological innovation, organizational capabilities, public policy instruments and institutional coordination. Whether through ESG-driven innovation, digital transformation, fiscal incentives, energy resilience or environmental regulation, the contributions collectively reinforce the idea that innovation is not merely a technological phenomenon but a multidimensional process shaped by economic, social and political forces. As organizations and governments continue to confront increasingly complex sustainability challenges, these studies provide valuable insights into the mechanisms through which innovation can contribute to long-term sustainable development (Engko and Rahmiati, 2025; Setiawan *et al.*, 2026; Calado *et al.*, 2026; Marques *et al.*, 2026; Castro Oliveira *et al.*, 2026).

Digital transformation, entrepreneurship and firm performance

Digital transformation increasingly operates at the intersection of entrepreneurial capabilities, ecosystem conditions and policy instruments, jointly shaping firm performance and innovation outcomes. Across diverse institutional contexts, evidence suggests that innovation is no longer driven primarily by internal R&D investments alone, but emerges from the interaction between firm-level resources and external enablers such as financing mechanisms, knowledge networks, consumer behavior and regulatory frameworks. As a result, digital transformation is better understood as a systemic and embedded process within entrepreneurial ecosystems, where performance outcomes depend on the alignment between internal capabilities and the broader institutional and behavioral environment. The studies in this section demonstrate that digital transformation and entrepreneurial performance arise from complex, multilevel interactions between firms, ecosystems, consumers and institutions, where innovation outcomes depend on the alignment of internal capabilities with broader institutional and behavioral environments, reinforcing the systemic nature of digital entrepreneurship and competitiveness (Rosa *et al.*, 2026; Manjarres-Henriquez *et al.*, 2026; Gu *et al.*, 2026).

Rosa *et al.* (2026) analyze SME internationalization intentions using survey data from 1,160 entrepreneurs in Quebec, Canada, combined with supervised machine learning (Decision Tree). The study identifies immigrant status, entrepreneurial experience and innovation activities as key predictors of internationalization intention. Financial needs and environmental engagement also play important roles. A key contribution is the shift toward intention-based analysis of internationalization, capturing early-stage behavioral drivers rather than realized outcomes. The findings highlight innovation as a central mechanism shaping global entrepreneurial orientation and emphasize the policy relevance of targeted support for SME international expansion (Rosa *et al.*, 2026).

Manjarres-Henriquez *et al.* (2026) examine innovation performance in technology-based firms in Colombia, focusing on low R&D-intensity environments. Using structural equation modeling (SmartPLS) on 63 firms, the study assesses the role of venture capital, networks, research capacity, technological infrastructure, and human capital in shaping process and product innovation. Results show that technological infrastructure and research capacity are the strongest determinants of innovation outcomes. Venture capital supports process innovation but not product innovation, while human capital and networks operate indirectly through relational mechanisms. Policy support influences innovation mainly through improved access to infrastructure and financing rather than direct effects. These findings underscore the importance of ecosystem coordination in resource-constrained contexts (Manjarres-Henriquez *et al.*, 2026).

Gu *et al.* (2026) adopt a dynamic modeling approach to examine the interaction between consumer smart preferences and financial subsidies in AI-driven markets. Their results reveal heterogeneous nonlinear effects. For core firms, a U-shaped relationship indicates that moderate subsidies and consumer preferences enhance profitability, while peripheral firms experience an inverted U-shaped effect, where excessive subsidies reduce returns. At the macro level, the combined effect on social welfare is also inverted U-shaped, highlighting trade-offs in policy design. The study emphasizes the need for differentiated subsidy strategies that reflect firm heterogeneity and market conditions (Gu *et al.*, 2026).

Innovation systems, industrial dynamics and knowledge development

Innovation systems are increasingly understood through their spatial, sectoral and knowledge-based dimensions, emphasizing that innovation emerges from the interaction between territorial structures, industrial dynamics and scientific knowledge production. Rather than being a uniform or linear process, innovation is embedded in specific regional, industrial and technological contexts, where ecosystem configurations, institutional arrangements and knowledge flows shape distinct development trajectories. Across these dimensions, innovation systems operate at multiple spatial and sectoral scales, with territorial conditions and knowledge structures jointly influencing innovation outcomes. Whether in rural development ecosystems or specialized industrial domains (Satolo and Careta, 2026), these studies reinforce the view that innovation is a geographically and institutionally embedded process driven by heterogeneous configurations of actors, resources and capabilities (Santos *et al.*, 2026).

Satolo and Careta (2026) examine rural innovation ecosystems in Brazil through a spatial clustering approach that integrates technological, institutional and sociodemographic variables. Using a DBSCAN-based methodology applied to municipal-level data, the authors identify nine distinct rural innovation clusters with heterogeneous structural characteristics. The findings demonstrate that technological capacity alone is insufficient to generate innovation outcomes; instead, innovation performance depends on the interaction between institutional articulation and local socioeconomic conditions. While some clusters exhibit high technological intensity but weak institutional coordination, others show stronger policy integration despite more limited infrastructure. This heterogeneity underscores the importance of place-based innovation policies that reflect territorial diversity rather than uniform national strategies. The study contributes a replicable hybrid analytical framework that combines spatial analysis with innovation systems theory, offering practical tools for differentiated rural development policy design (Satolo and Careta, 2026).

At the sectoral and knowledge production level, Santos *et al.* (2026) provide a comprehensive bibliometric analysis of sparkling winemaking research over a 25-year period (1998–2023). Based on a structured PRISMA selection process and analysis of 103 core publications using Biblioshiny (RStudio), the study maps the evolution of scientific knowledge in this specialized agro-industrial domain. The findings reveal clear innovation trends, particularly in temperature-controlled fermentation, automation of production processes, and bottling technologies. These developments reflect broader patterns of technological upgrading in food and beverage industries, where incremental innovation and process optimization play a central role in productivity and quality improvements.

Beyond mapping past developments, the study also provides a forward-looking research agenda, identifying areas where future technological investments and scientific inquiry are likely to be concentrated. In doing so, it contributes to a better understanding of how specialized industrial knowledge evolves over time and how innovation trajectories are shaped by both scientific progress and industrial demand (Santos *et al.*, 2026).

Conclusion

Across the contributions in this special issue, a coherent narrative emerges: innovation, sustainability and development are no longer separable domains but mutually reinforcing dimensions of contemporary economic and institutional transformation along these streams. Innovation operates as a systemic phenomenon embedded in firms, entrepreneurial ventures, markets, policy regimes and territorial structures, rather than as an isolated technological output.

In the first stream, the evidence highlights how sustainability-oriented innovation is shaped by the interaction between ESG strategies, digital transformation, fiscal incentives, geopolitical dynamics and environmental regulation. Whether through green innovation and firm value creation, the enabling role of digital technologies in sustainability performance, or fiscal instruments as behavioral policy tools, the findings underscore that sustainability outcomes depend on coordinated institutional and technological architectures. At a broader systemic level, energy security and geopolitical uncertainty, as well as environmental regulatory effectiveness, further illustrate how external shocks and institutional design shape sustainability trajectories.

The second stream emphasizes that digital transformation and entrepreneurship are fundamentally relational processes. Firm performance is shown to depend on the interaction between internal capabilities and external ecosystems, including finance, networks, human capital and policy environments. Empirical evidence from SME internationalization, technology-based entrepreneurship in emerging economies, and AI-driven market dynamics consistently points to heterogeneous, nonlinear and context-dependent innovation effects.

Finally, the third stream situates innovation within spatial, sectoral and knowledge-based systems. Rural innovation clusters in Brazil and long-term technological evolution in specialized industries demonstrate that innovation trajectories are deeply shaped by territorial conditions, institutional coordination and cumulative knowledge development.

This special issue advances a unified perspective in which innovation is understood as a multilevel, institutionally embedded and dynamically evolving process. It highlights the importance of aligning technological capabilities, policy frameworks and ecosystem conditions to enable sustainable and resilient forms of economic development.

José Morais
Department of ESCE, ISPGAYA, Vila Nova de Gaia, Portugal, and

Rodrigo Cortopassi Goron Lobo
Department of Business Administration, Instituto Superior Politécnico de Vila Nova de Gaia, Vila Nova de Gaia, Portugal

References

Audretsch, D.B. and Belitski, M. (2021), "Towards an entrepreneurial ecosystem typology for regional economic development: the role of creative class and entrepreneurship", *Regional Studies*, Vol. 55 No. 4, pp. 1-22, doi: 10.1080/00343404.2020.1854711.

Calado, S., Veloso, C.M., Azevedo, G. and Cruz, S. (2026), "Corporate tax benefits as behavioural policy tools: fiscal innovation and evidence from Portugal", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 963-984, doi: 10.1108/IJIS-05-2025-0256.

Caldara, D. and Iacoviello, M. (2022), "Measuring geopolitical risk", *American Economic Review*, Vol. 112 No. 4, pp. 1194-1225, doi: 10.1257/aer.20191823.

Castro Oliveira, J., Robaina, M. and Nogueira, M.C. (2026), "WEEE legislation in the European Union: analysis of the Portuguese case", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 943-962, doi: 10.1108/IJIS-03-2026-0153.

Chaminade, C. and Edquist, C. (2010), "Rationales for public policy intervention in the innovation process: systems of innovation approach", in Lorenz, J. and Lundvall, B.A. (Eds), *How Europe's Economies Learn: Coordinating Competing Models*, Oxford University Press, Oxford, pp. 95-114.

Chen, Y., Chen, M., Li, Y., Wang, B., Chen, S. and Xu, Z. (2018), "Impact of technological innovation and regulation development on e-waste toxicity: a case study of waste mobile phones", *Scientific Reports*, Vol. 8 No. 1, p. 7100, doi: 10.1038/s41598-018-25400-0.

Chouaibi, S., Chouaibi, J. and Rossi, M. (2022), "ESG and corporate financial performance: the mediating role of green innovation: UK common law versus Germany civil law", *EuroMed Journal of Business*, Vol. 17 No. 1, pp. 46-71, doi: 10.1108/EMJB-09-2020-0101.

Engko, C. and Rahmiati, A. (2026), "ESG performance and firm value: green innovation as a mediator variable (evidence from Indonesia)", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 1028-1047, doi: 10.1108/IJIS-04-2025-0190.

Gruba, M.C., Denes, D., Lobo, R.C.G. and Isaak, A.J. (2022), "Circular economy initiatives: strategic implications, resource management, and entrepreneurial innovation in a Brazilian craft beer ecosystem during the COVID era", *Sustainability*, Vol. 14 No. 19, p. 11826, doi: 10.3390/su141911826.

Gu, J., Xie, W., Chen, Y. and Yu, J. (2026), "A dynamic model considering consumer smart preferences and financial subsidy", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 1065-1096, doi: 10.1108/IJIS-05-2025-0228.

Han, X., Khouja, M. and Liu, X. (2023), "A dynamic model considering consumer green awareness and environmental subsidy", *International Journal of Production Economics*, Vol. 260, p. 108840, doi: 10.1016/j.ijpe.2023.108840.

Lobo, R.C.G., Pigatto, M.B., Denes, D. and Isaak, A.J. (2025), "The role of intermediaries in sociotechnical transitions: a systematic framework towards sustainability management", *Business Strategy and the Environment*, Vol. 34 No. 4, pp. 1-21, doi: 10.1002/bse.4237.

Manjarres-Henriquez, L., Jimenez-Celin, Y. and Amar-Sepúlveda, P. (2026), "Unpacking innovation in technology-based entrepreneurship: the role of venture capital, networks and research capacity in an emerging economy", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 1007-1028, doi: 10.1108/IJIS-05-2025-0282.

Marques, J., Madaleno, M. and Nogueira, M.C. (2026), "Geopolitical risks and energy commodities dynamics in G7 economies towards business sustainability", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 921-942, doi: 10.1108/IJIS-06-2025-0310.

Rosa, J.G., Agredano, F. and Mejia-Morelos, J.H. (2026), "Internationalization, environmental engagement and innovation: insights from machine learning methods", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 1097-1122, doi: 10.1108/IJIS-05-2025-0271.

Santos, V., Bacalhau, L., Baptista, A., Bastos, B., Almeida, H. and Pinhal, R. (2026), "A 25-year bibliometric analysis of the management of sparkling winemaking processes: innovation trends and future research agenda", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 985-1007, doi: 10.1108/IJIS-07-2025-0348.

Satolo, L.F. and Careta, C.B. (2026), "Mapping innovation ecosystems in rural Brazil: a spatial clustering approach to policy and productive capacity", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 1048-1064, doi: 10.1108/IJIS-05-2025-0287.

Setiawan, N., Rahmiati, A. and Soewarno, N. (2026), "The mediating role of digital technology in the relationship between green innovation and business performance: evidence from Indonesia's automotive industry", *International Journal of Innovation Science*, Vol. 18 No. 4, pp. 1123-1139, doi: 10.1108/IJIS-03-2025-0152.

Walter, C.E., Au-Yong-Oliveira, M., Miranda Veloso, C. and Polónia, D.F. (2022), "R&D tax incentives and innovation: unveiling the mechanisms behind innovation capacity", *Journal of Advances in Management Research*, Vol. 19 No. 3, pp. 367-388, doi: 10.1108/JAMR-06-2021-0194.

Yin, S. and Yu, Y. (2022), "An adoption-implementation framework of digital green knowledge to improve the performance of digital green innovation practices for industry 5.0", *Journal of Cleaner Production*, Vol. 363 No. January, p. 132608, doi: 10.1016/j.jclepro.2022.132608.

Further reading

Cravero, M. (2023), "Innovations in sparkling wine production: a review on the sensory aspects and the consumer's point food research of view", *Beverages*, Vol. 9 No. 3, doi: 10.3390/beverages9030080.