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Review

Open Innovation and Entrepreneurship: A Review from the Perspective of Sustainable Business Models

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Abstract: Open innovation serves as a critical pathway for aligning Sustainable Business Models (SBMs) with the dual imperatives of the sustainable economy and the digital economy. This editorial review synthesizes insights from theoretical frameworks, particularly the Resource-Based View (RBV) and Transaction Cost Theory (TCT), integrated with the Technology-Organization-Environment (TOE) framework to explore the mechanisms driving open innovation. Our editorial review highlights key dimensions influencing open innovation: technology (digital platforms, emerging technologies like AI, IoT, and blockchain), organization (stakeholder collaboration, governance mechanisms), and environment (regulatory frameworks, market dynamics, and industrial spillovers). This unified framework offers actionable insights for policymakers to foster enabling ecosystems and for business leaders to adopt open innovation strategies for resource optimization and governance improvement. The review concludes that the RBV-TCT-TOE framework provides a generalizable and robust tool for understanding and advancing open innovation across industries and regions, bridging theoretical and practical dimensions to address the challenges of sustainability and digital transformation.

Keywords: Open Innovation; Entrepreneurship; Sustainable Business Model.

1. Introduction

The dual pressures of climate change and technological change have created a dilemma for businesses [1]. On the one hand, companies are increasingly urged to adopt Sustainable Business Models (SBMs) to address environmental and societal challenges [2–4]. On the other hand, transition to the digital economy demands continuous innovation, driven by the rapid integration of digital technologies such as artificial intelligence (AI), Internet of Things (IoT), big data, and block-chain [5, 6]. These two imperatives, sustainability and digitalization, are often perceived as conflicting priorities, as sustainability emphasizes long-term ecological and social value, while digitalization accelerates short-term innovation and competition. The question arises: *How can business models be simultaneously innovative and sustainable?*

A common characteristic of both the sustainable economy and the digital economy is the presence of externalities. Environmental degradation generates negative externalities, while transitioning to an environmentally sustainable economy results in positive externalities. Similarly, digital technologies exhibit complex externalities that impact countries, industries, firms, and individuals. In addressing these externalities, economic theory suggests two primary approaches: government-based interventions (e.g., taxes, regulations, and standards) and market-based mechanisms (e.g., cap-and-trade systems, Coasean

bargaining, and collaborative solutions). Both approaches aim to internalize the external costs and benefits, aligning private incentives with societal welfare.

Open innovation, a concept popularized by Chesbrough [5], offers a potential market-based solution to externalities by providing a route for collaboration and resource-sharing across organizational boundaries. It has been widely recognized for its ability to enhance innovation efficiency and reduce costs through external partnerships and digital platforms [7]. However, its integration with sustainability goals remains a subject of debate. While some argue that open innovation integrates seamlessly with sustainability by fostering collaborative problem-solving and resource optimization [8], others highlight challenges such as the difficulty of balancing stakeholder interests and maintaining equitable resource distribution [9].

This puzzle is further complicated by the varying dynamics of entrepreneurial ecosystems. For instance, digitalization-driven ventures often prioritize scalability and speed, potentially sidelining environmental and social considerations [10]. Conversely, sustainability-focused entrepreneurs may struggle to use digital tools effectively, limiting their capacity for innovation [11]. This divergence highlights the need to explore how open innovation can mediate between these two domains, creating a synergistic pathway for sustainable entrepreneurship.

The current literature review aims to discuss this critical dilemma by examining the intersection of entrepreneurship, open innovation, and SBMs. Specifically, it highlights how open innovation operates at the crossroads of the sustainable economy and the digital economy, integrating insights from recent academic contributions in these fields. By synthesizing evidence from the general literature and articles published in the special issue “*Entrepreneurship and Open Innovation from the Perspective of Sustainable Business Models*” in *Sustainability*, this **editorial review** aims to clarify how businesses can utilize open innovation to address the challenges of sustainability and digitalization. Note that this editorial review is not to formally build a theory or empirically test a theory, but to offer some reflections based on the special issue, which can be generalized to broader literature and future research.

To achieve this goal, this review attempts to answer three research questions:

RQ1. Can we position articles in the special issue in a unified framework?

RQ2. Can we position broad literature on open innovation in the same framework?

RQ3. Can we infer future research agenda using the same framework?

Following the introduction, section 2 critically reviews the general literature on open innovation at the intersection of digitalization and sustainability, resulting in a unified theoretical framework (RBV-TCT-TOE). We apply this framework to analyze some prominent themes in literature. Then, section 3 briefly overviews the papers published in the special issue and position them in the theoretical framework. Grounded on the review and the overview, section 4 proposes some future research agenda reflecting the gap in literature. Section 5 concludes.

2. A Review of Literature

Open innovation serves as a significant pathway that bridges the sustainable economy—which emphasizes long-term value creation through the minimization of ecological and societal costs [12], and the digital economy—which is characterized by the transformation of traditional economic processes via digital technologies [13]. This section reviews the theoretical foundations of open innovation within these two economic trends, revealing the interconnections among key concepts based on recent publications, including but not limited to those in the current special issue.

As conceptualized by Chesbrough [5], open innovation involves the strategic utilization of both external and internal ideas and pathways to advance technology and product development. This paradigm facilitates the integration of diverse knowledge sources, thereby fostering innovation that harmonizes with both sustainability objectives and digital transformation. To comprehensively understand the mechanisms underpinning open innovation, it is essential to examine it through two fundamental theoretical lenses in the literature: the Resource-Based View (RBV) and Transaction Cost Theory (TCT).

The RBV posits that a firm's competitive advantage is derived from its unique resources and capabilities that are valuable, rare, inimitable, and non-substitutable [14]. In the context of open innovation, RBV suggests that firms can enhance their innovative capacity by accessing external resources and knowledge, thereby complementing and augmenting their internal capabilities [15]. This external sourcing allows firms to integrate diverse knowledge bases, facilitating innovation that aligns with sustainability objectives and digital transformation [16]. However, this approach also necessitates the development of absorptive capacity to recognize, assimilate, and apply external knowledge effectively [17]. Firms with high absorptive capacity can better utilize external innovations to enhance their internal resource base, thereby achieving a competitive edge [18]. In the following bullet points, we summarize some popular themes developed in the open innovation literature in line with RBV.

- **Digital Capability.** RBV implies an essential role of digital capability (as part of technological capability) in fostering business model innovation and sustainability performance [19]. Early evidence shows that big data analytics enhances a firm's dynamic fit with evolving environmental demands [20]. Information management in general is a critical digital capability enabling sustainability and green innovation [21]. Recent research identifies the mediating role of inbound and outbound open innovation in enhancing the link between digital capability and sustainable performance [22].
- **Stakeholder Theory.** Stakeholder theory complements RBV by addressing normativity, sustainability, and collaboration, advancing a more holistic understanding of firm resources [23]. Co-creation and collaborative ecosystems are identified as key mechanisms for developing sustainable innovations [24, 25], but stakeholder engagement in collaborative research and innovation projects poses significant challenges. The analytic network process method is proposed to effectively prioritize stakeholders in collaborative projects, consistent with sustainability and stakeholder theory principles [26].
- **Network Theory.** Sustainable innovation systems are interconnected with resource pathways, with different network structures depending on the type of resource renewal cycle involved, and unexpected elements like universities' roles [27]. Networks in the energy sector drive changes in business models for sustainability, promoting value creation

for both companies and society, while also fostering new resource dependencies on network partners and the network itself [28]. Recent evidence in China suggests that green innovation network embeddedness positively impacts corporate environmental responsibility, particularly in enterprises with high-level political ties, loose financing restrictions, and nonstate ownership [29].

TCT examines the costs associated with economic transactions among organizations, proposing that firms organize activities to minimize transaction costs, which include search, negotiation, and enforcement expenses [30, 31]. Open innovation can be motivated by transaction cost factors such as asset specificity, transaction frequency, and behavioral uncertainty [32]. However, it also involves extensive collaboration with external partners, which can lead to increased transaction costs due to factors such as opportunism, contractual complexities, and coordination challenges [33]. Therefore, firms must carefully assess the trade-offs between the benefits of accessing external knowledge and the associated transaction costs [34]. Effective governance mechanisms, such as trust-based relationships and robust contractual agreements, are crucial in mitigating these costs and facilitating successful open innovation practices [35]. We summarize some representative themes developed along TCT.

- **Digital Platform.** Digitalization and digital platforms lead to transaction cost reduction and open innovation incentives in the context of SBMs [1]. Literature highlights the importance of e-marketplace business models and their customer-centric value propositions in effectively communicating and ensuring high levels of us-ability and stability in the digital platform [36]. Sustainable entrepreneurship on digital platforms is shown to enact digital connectivity to capture and create value [37].
- **Governance Structure.** Empirical evidence shows that innovation impacts vertical structure of firms, influenced by transaction costs and competences [38]. However, it is criticized that an overemphasis on calculative reduction of transaction costs together with a focus on governance and rationality leaves little space for an innovative climate [39]. More recent literature focuses on how SBMs can contribute to better ESG performance 2 and supply chain management [40].
- **Industrial Dynamics.** Firms' adoption of open innovation is influenced by transaction costs, technological regimes, and their strategic position within innovation systems [41]. Recent literature on the adoption of open innovation in manufacturing emphasizes the interplay with sustainability and Industry 4.0 practices [42]. Evidence suggests that Industry 4.0 technologies and open innovation positively impact green innovation performance in manufacturing firms, leading to decreased transaction costs and sustainable innovations [43].

Integrating insights from RBV and TCT provides a comprehensive theoretical framework for understanding open innovation. While RBV emphasizes the role of both internal and external resources to build competitive advantage, TCT focuses on the efficiency of transactions involved in acquiring these resources. By balancing the strategic benefits of resource acquisition with the need to minimize transaction costs, firms can effectively implement open innovation strategies that support sustainable and digital transformation goals.

Another perspective to look at the themes of both RBV and TCT is the Technology, Organization, and Environment (TOE) framework, originally designed for technology

adoption [44]. The three dimensions (TOE) are regarded as “contexts” because it emphasizes the multiple, interconnected settings that shape an organization’s decision-making and behavior [6]. Both digital capability and digital platform are in the technology (T) dimension, emphasizing the prominence of the digital economy in open innovation. Stakeholder theory and governance structure highlight the organization (O) dimension, arguing for the importance of organizational resources and capabilities. Network theory and industrial dynamics underscore the environmental (E) dimension, stressing the factors from outside.

Figure 1 demonstrates the multi-dimensionality of literature through both theories focusing on “why” (RBV-TCT) and contexts focusing on “what” (TOE). This unified RBV-TCT-TOE framework is useful for researchers to review academic literature and for managers to navigate the challenges and opportunities presented by the convergence of sustainability imperatives and digital transformation.

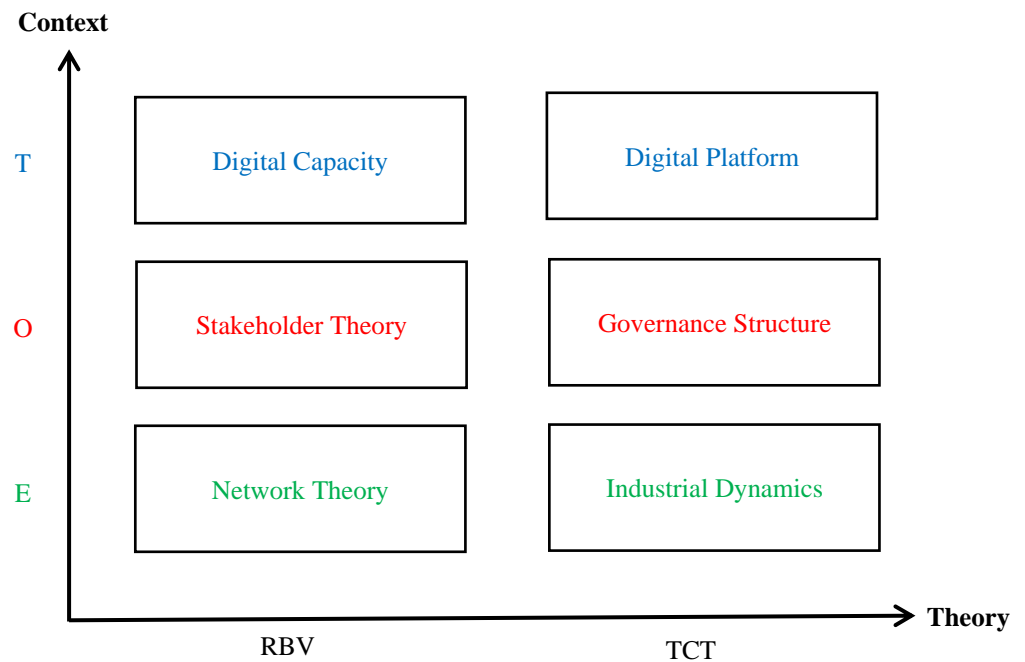


Figure 1. Multi-dimensionality of the open innovation literature.

Table 1. Recap table for the RBV-TCT-TOE framework

Dimension	RBV	TCT
Technology (T)	Digital capability as a firm resource enabling innovation and sustainability.	Reduction of transaction costs through digital platforms and technologies.
Organization (O)	Stakeholder collaboration for resource co-creation and governance improvement.	Governance structures to balance costs and mitigate risks in partnerships.
Environment (E)	External networks and ecosystems fostering resource access and knowledge sharing.	Industrial dynamics influencing transaction costs in adopting sustainable innovation practices.

To clarify the integration of the RBV-TCT-TOE framework in the literature reviewed, Table 1 summarizes key themes and their alignment with each theoretical and contextual

dimension. This recap offers readers an intuitive understanding of how the framework organizes insights from open innovation literature.

It is worth noting that the six themes summarized in this section are not all themes in the literature. We only pick the most popular and representative ones. There are other emerging themes which can also be analyzed by the unified framework. For example, start-up entrepreneurship [32, 45] can be categorized as the intersection between the RBV-dimension and the O-dimension.

Despite substantial advancements in understanding open innovation's role in SBMs, several gaps remain unaddressed. Theoretically, the integration of frameworks like RBV, TCT, and TOE has provided a multi-dimensional lens, but future research must explore underdeveloped constructs such as the dynamic capabilities required for sustained innovation under environmental uncertainty. Empirically, studies predominantly focus on developed economies and large corporations, leaving gaps in understanding how SMEs or firms in emerging markets navigate the dual imperatives of sustainability and digitalization. Managerially, literature lacks actionable frameworks for addressing stakeholder conflicts and scaling sustainable practices. Methodologically, limited adoption of longitudinal or mixed-method designs restricts insights into the temporal and multi-faceted impacts of open innovation. Addressing these gaps will not only enrich theoretical contributions but also provide robust tools for practitioners and policymakers navigating the complexities of sustainable innovation.

3. An Overview of the Special Issue

The special issue *“Entrepreneurship and Open Innovation from the Perspective of Sustainable Business Models”* explores how SBMs can be driven by and contribute to entrepreneurship and open innovation. Five papers have been published in the special issue as of December 2024. This section gives a brief overview of the published papers and their positionings in the unified RBV-TCT-TOE framework.

Sun et al. [46] explore the mechanisms driving users' continuous contribution behavior in open innovation communities, employing the Stimulus-Organism-Response (S-O-R) theory as the analytical framework. The study conceptualizes user benefits such as stimuli, self-verification as the organism, and continuous contribution behavior as the response. Using data from 469 users of Huawei and Xiaomi innovation communities in China, the authors investigate how economic, functional, social, and self-fulfillment benefits impact self-verification and, subsequently, contribution behavior. Additionally, they introduce the moderating role of future work self-salience, which influences the relationship between user benefits and self-verification. Their findings reveal that while economic, functional, and self-fulfillment benefit positively mediate contribution behavior through self-verification, social benefits fail to show significant mediation. The results underscore the importance of future work self-salience, which positively moderates the effects of economic, functional, and self-fulfillment benefits on self-verification but not those of social benefits.

This study emphasizes the role of user benefits and intrinsic motivators (e.g., self-verification and self-salience) in fostering continuous contribution behavior. These are intangible resources critical for sustainable engagement in open innovation communities, consistent with the RBV framework. The focus is on how organizational mechanisms, such as user interaction and perceived benefits, influence innovative behaviors, placing emphasis on organizational dynamics.

Plečko et al. [47] investigate the factors influencing the adoption of digital technologies in sales among entrepreneurs, focusing on demographic and motivational

dimensions. Using data from the Global Entrepreneurship Monitor (GEM) survey, the study analyzes responses from 464 entrepreneurs in Slovenia and Croatia through logistic regression. The findings indicate that demographic factors, including gender, age, and education, have no significant impact on digitalization in sales. In contrast, altruistic motivations—such as the desire to make a difference in the world—positively influence digital adoption, while other motives, including income generation or family tradition, do not. The study highlights the unique role of altruistic goals in promoting digital transformation and suggests that digitalization extends beyond profit-driven objectives to integrate into broader sustainable business practices.

By examining the adoption of digital sales technologies, the study highlights cost-related factors influencing digitalization decisions, in line with TCT's focus. The study is primarily concerned with technological adoption, such as the integration of digital tools into sales strategies, positioning it within the technological dimension.

Mais & Bauernhansl [11] investigate the design options for integrating sustainability and openness into business models. They propose a taxonomy-based approach to develop Sustainable Open Business Models (SOBMs) that address the decarbonization challenges faced by energy-intensive manufacturing industries (EIMI). The study employs a structured literature review to identify 64 design options categorized across four meta-dimensions (value creation, value proposition, value delivery, and value capture) and nine dimensions. The taxonomy development process combines theoretical and empirical approaches, validated through case classifications and expert interviews. The research provides actionable frameworks for practitioners and academics aiming to achieve sustainability with business innovation.

The taxonomy of sustainable and open business models draws heavily on the strategic use of resources to achieve competitive and sustainable outcomes, consistent with RBV. The research addresses technological tools and organizational strategies, reflecting how these dimensions interact to enable sustainable innovation.

Tekala et al. [48] explore the relationship between Green Entrepreneurship (GEN) and Business Sustainability (BS), emphasizing the mediating role of Green Structural Capital (GSC) and the moderating effect of Environmental Dynamism (ED). Using Green Theory as the theoretical foundation, the study analyzes data collected from 443 SMEs across Istanbul and Izmir, Turkey. The authors employ structural equation modeling (SEM) to examine these relationships and find that GEN positively influences BS, both directly and through GSC. Additionally, ED negatively moderates the GEN-BS relationship, indicating that GEN's impact on BS is stronger in less dynamic environments. The study contributes to the understanding of green entrepreneurship within emerging markets and offers insights into the role of internal and external factors in driving sustainability.

The study investigates green structural capital and its mediating role in achieving sustainability goals, emphasizing the strategic use of resources in dynamic conditions, consistent with RBV. By focusing on environmental dynamism and organizational resources like green structural capital, this paper spans both environmental and organizational dimensions.

Yuan et al. [49] explore the impact of Cross-border E-Commerce Pilot (CECP) policies on urban entrepreneurial vitality in China. Using a quasi-natural experiment design, the authors analyze panel data from 278 Chinese cities between 2010 and 2020. Their findings reveal that CECP policies significantly enhance entrepreneurial vitality, with an increase of 13.3% in new enterprise registrations in pilot areas. The mechanisms underlying this impact include improvements in the business environment, industrial synergy and agglomeration, and expanded market scale. Additionally, spatial spillover effects are

observed, as the benefits extend to neighboring cities. The study highlights the heterogeneity of these effects across regions, city sizes, innovation levels, and industry types.

This paper explores how cross-border e-commerce reduces market entry costs and transaction inefficiencies, a classic application of TCT in reducing barriers to entrepreneurial activities. The focus on environmental spillovers and the broader impact of policy interventions places this study squarely within the environmental dimension.

4. Future Research Agenda

The following research directions are grounded in recent literature on open innovation and SBMs. We present the future research agenda using the RBV-TCT-TOE framework.

- **[RBV+O] Organizational Resources in Sustainable Open Innovation.** RBV highlights that SBMs rely on unique, firm-specific resources to achieve competitive advantage [45]. Future research can investigate how combinations of tangible resources, such as digital infrastructure, and intangible resources, such as knowledge capital, enable sustainable open innovation. The literature highlights the role of partnerships, including collaborations with academia, in addressing resource constraints for SMEs [50]. However, more nuanced insights into the configurations and complementarities of these resources remain unexplored.
- **[TCT+OE] Transaction Costs and Collaborative Innovation.** TCT underscores the importance of managing uncertainty, asset specificity, and governance mechanisms in inter-organizational collaboration [51]. Collaborative relationships with government and academic institutions can help SMEs reduce transaction costs, enabling more sustainable innovation processes [52]. A promising direction for future studies is the development of governance architecture to optimize transaction costs in open-innovation ecosystems, with a particular focus on SMEs.
- **[RBV/TCT+TE] Technology Integration in SBMs.** Emerging technologies, such as AI, IoT, and blockchain, have the potential to transform SBMs by increasing transparency, traceability, and operational efficiency [53]. Future research should assess the readiness of firms to adopt these technologies and their role in facilitating open innovation for sustainability. Additionally, the impact of regulatory schemes and societal pressures on technology adoption merits investigation.
- **[RBV/TCT+OE] Ecosystem Dynamics in Open Innovation.** Collaboration at the ecosystem level, facilitated by digital platforms, can enable low-cost and high-impact stakeholder integration for sustainable innovation [2]. Despite its importance, there is limited understanding of the mechanisms for balancing stakeholder interests and mitigating opportunistic behavior within these networks. Future studies could explore how ecosystem dynamics shape sustainable innovation outcomes, particularly in multi-stakeholder contexts.
- **[RBV+TOE] Impact of Open Innovation on Sustainability Performance.** Open innovation initiatives have been linked to sustainability-oriented innovation, yet their tangible impact on environmental, social, and economic performance remains insufficiently examined [54]. Research is needed to develop robust metrics to quantify these outcomes comprehensively and commensurably [55]. Longitudinal studies can further illuminate the long-term sustainability impact of open innovation across industries and regions.

The proposed research agenda is in line with the growing need for evidence-based frameworks that can guide firms in leveraging open innovation for long-term sustainability goals. By linking RBV, TCT, and TOE to the sustainable and digital economies, this research agenda not only addresses theoretical gaps but also aligns with pressing global imperatives. Firms that effectively utilize this integrated framework can position themselves as leaders in advancing sustainability through digital innovation, creating value for both stakeholders and society at large. This alignment ensures that the transition to a sustainable economy is underpinned by actionable, evidence-based strategies that harness the transformative potential of the digital economy.

5. Conclusion

This literature review explores the intersections among entrepreneurship, open innovation, and SBMs. Based on general literature and papers in the special issue, we have established a unified RBV-TCT-TOE framework. It highlights how RBV and TCT offer complementary perspectives on the mechanisms underpinning open innovation. RBV emphasizes the strategic utilization of internal and external resources, while TCT focuses on minimizing transaction costs in collaborative endeavors. The TOE framework contextualizes these theories across technological (T), organizational (O), and environmental (E) dimensions, creating a comprehensive approach to understanding the role of open innovation in addressing challenges in sustainable and digital economies. The RBV-TCT-TOE framework is applied to analyze the papers in the special issue (RQ1) and in broad literature (RQ2) as well as the future research agenda (RQ3).

The literature reveals that digital platforms and emerging technologies such as AI and IoT enable firms to enhance efficiency and transparency while fostering innovation. Stakeholder collaboration and governance structures are critical for leveraging resources and aligning goals in sustainable innovation. External factors such as regulatory frameworks, market dynamics, and industrial spillovers significantly influence entrepreneurial vitality and the adoption of sustainable practices.

The findings provide actionable insights for policymakers and business leaders. (i) Policymakers: To foster sustainable entrepreneurship, governments should invest in digital infrastructure, create supportive regulatory environments, and incentivize collaborations across academia, industry, and civil society. Policies promoting open innovation ecosystems can reduce transaction costs, encourage resource sharing, and enhance regional competitiveness. (ii) Business decision-makers: firms should adopt open innovation practices by leveraging digital platforms and external networks to integrate sustainability into their business models. Organizational efforts should focus on building absorptive capacity and establishing governance mechanisms that balance stakeholder interests and mitigate opportunistic behavior.

The RBV-TCT-TOE framework developed in this review offers a robust, multidimensional approach, applicable across various contexts. By integrating RBV and TCT, the framework elucidates “why” firms adopt open innovation strategies, while the TOE dimensions address “what” contextual factors influence these decisions. This unified framework provides a flexible tool for analyzing innovation ecosystems and guiding decision-making in diverse settings, making it highly generalizable for both academic research and managerial practice.

In conclusion, open innovation lies at the crossroads of the sustainable economy and the digital economy, offering transformative opportunities for businesses to achieve long-term competitiveness while addressing global sustainability challenges. By applying the RBV-TCT-TOE framework, organizations can strategically navigate these complexities and contribute to building a resilient, sustainable future.

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