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Editorial

Insights and Implications of the Special Issue Titled: "The Path to Sustainable Technological Entrepreneurship"

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1. Technological Entrepreneurship Encountering Sustainability

The objective of this Special Issue was to highlight the challenges and opportunities in conceiving, designing, building, utilizing, and commercializing novel technology solutions aiming to impact individuals and communities around the world. It highlights the role of technological entrepreneurship in the ecosystem of environmental–social–economic sustainable development, both in global and local contexts. This Special Issue brings with it the need to invest in a wide-ranging and profound debate on economic principles and a radical reform of regulations and incentives toward meeting the goals of sustainability. Future research is expected to build a more robust understanding of how technological entrepreneurship will foster sustainable development, while contributing to global economic, social, and environmental goals.

Sustainability has gained a larger amount of attention since 2015 when 195 nations agreed with the United Nation agenda of the Sustainable Development Goals (SDGs). The agenda is addressed by 17 challenges, in which the following four key dimensions are included: inclusive social development, inclusive economic development, environmental sustainability, and peace and security [1]. Due to the rapidly changing market environment, entrepreneurial orientation is of paramount importance for SMEs in improving their performance and providing a sustainable source of growth [2]. In recent academic research, sustainability has provided a growing number of published papers with an increasing impact factor. Many experts and researchers dealing with sustainability have published in this journal. The challenges of sustainability are increasingly complex, and our Special Issue is focused on sustainable technological entrepreneurship.

This Special Issue is aimed to explore perceptions, theories, policies, strategies, and practices related to various ways in which technology can and should serve global challenges. In addition to exploration, it calls for providing better understanding on whether and how novel technological initiatives can and should be conceptualized, structured, and operated in a sustainable manner in line with the double or triple bottom line. The concept where businesses should aim to create economic value as well as environmental and social value was presented in 2004 [3] and afterwards was widely adopted (e.g., [4]).

This Special Issue presents seven papers which explored different aspects of innovative sustainable technologies. It refers to high technologies as well as traditional industries.

2. Entrepreneurship in Sustainable Technological Traditional Industries

1. The tire industry involves polluting processes; however, innovative recycling methods of reprocessing tire rubber can offer a pathway towards achieving circular economy objectives. Roetman et al. (2024) interviewed 12 organizations that develop or utilize technologies for the devulcanization of tire rubber, out of 36 organizations across Europe that deal with devulcanization to transform rubber from end-of-life tires into a valuable resource for new rubber products. They found that the development of various devulcanization approaches for diverse types of products created opportunities

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for upscaling. To capitalize on these opportunities, organizations need to collaborate throughout the entire value chain of tire production and recycling. The researchers concluded that achieving this collaboration requires interventions across the industry.

2. Environmental pollution is a persistent problem in remote terrestrial ecosystems, which motivated Özbek et al. (2022) to investigate the extent and patterns of tourists' littering on three popular hiking trails located in northeastern Italy. Even though littering was found to be widespread along the trails, the outcomes of the study reveal diverse patterns based on the litter's density while highlighting the prevalence of plastic pollution. Another revealed pattern is based on voluntary and involuntary littering. The authors recommend sustainable practices of mountaineering supervision for waste management and maintenance on-site, along with raising GIS (geographic information system) tech-based participatory awareness.
3. The Chinese policy related to returnees' entrepreneurship, as regulated by local governments, was explored by Qi and Han (2022). Policy attention reflects the importance that local governments attach to this issue since it promotes the sustainable development of the returnees and regions. The researchers found that the policy attention evolution on space dimension is closely linked to "pull" and "push" forces of local population flow and has effects on the neighborhood. Another finding shows that due to the gradual improvement of the relevant infrastructure and the entrepreneurial environment since 2016, Chinese local governments dispersed policy attention on promoting returnee entrepreneurship and moved to other policy and social fields with less intensified collaborative social network. This research provides insights from China's experience, which may help other countries in exploring ways to promote the sustainable development of returnees and their ecosystem.
4. Remanufacturing is a sustainable strategy which enables producers to considerably lessen their capital production costs and give consumers access to like-new products at lower prices than new goods. However, the decision to pursue remanufacturing is a challenge because the original equipment manufacturers (OEMs) may cannibalize the demand for their new products. Wo and Li (2022) studied the key factors that influence OEMs' choice of remanufacturing strategies. OEMs can produce remanufactured products to compete with independent remanufacturers (IRs), or they can authorize IRs to cooperate because of their seller reputation. They found that when the authorization fee is higher than a certain value, even if the remanufactured product poses a competitive threat to the new product, the OEM will help the IR improve their remanufacturing technology. The researchers concluded that regardless of authorization or a competitive scenario, this strategy saves costs, achieving a win–win situation. The improvement in remanufacturing technology by OEMs can increase the output of remanufactured products, which consequently is conducive to environmental protection.

3. Entrepreneurship in Sustainable High-Tech Industries

1. The COVID-19 epidemic in early 2020 has added a strong impulse to the acceleration of the smart economy. Chinese digital platform companies have begun the process of digital innovation, highlighting the unique characteristics of the platform economy in resource allocation. Deng et al. (2022) propose a framework model for the profit mechanism of digital platforms, solving the problems faced by many traditional enterprises in the internet age, while the profit theory of traditional monopolies is not suitable for the rapidly changing internet economy. The proposed profit framework uses the symbiotic logic of value sharing to explain the underlying logic of platform profitability. The researchers found that the key to digital platform companies' profitability lies in the symbiotic synergy between platform companies and massive userbases. Another finding shows that the profit condition of platform enterprises is digital capability rather than system possession. The implementation of a flexible platform strategy promotes the further development of a differentiation strategy and lowers

the barriers to entry in the industry, while enabling the platform and manufacturers to realize value co-creation. The researchers concluded that, on the one hand, platform enterprises can obtain greater market performance, while on the other hand, it can satisfy users' personalized needs.

2. As eco-efficiency is based on profit-maximizing goals, the pace of the transition is unlikely to peak quickly. In fact, this profit motive restrains firms from fully embedding ecological principles in their choices. Some behavioral concerns arise, as rationally bound firms are likely to pursue uncomplicated and effortless pathways to safeguard profits. In this article, Gambarotto et al. (2023) analyze the technological and economic features of eco-efficient technologies and reflect on the conditions that allow firms to play a leading role in the ecological transition process. As aforementioned, they argue that eco-efficiency is based on profit-maximizing goals, so the pace of the transition is unlikely to peak quickly. Consequently, new moral values must become pivotal criteria in firms' decision-making processes. The big ecological challenge must become widely accepted in social discourse with the involvement of all economic actors to trigger a general process of institutional change.
3. The case of Estonia as an example of a twin (digital and green) transition was examined by Kekkonen et al. (2023). They explored entrepreneurs' perceptions of challenges and opportunities related to shifting towards a low-carbon economy. The perceived entrepreneurial opportunities related to green transitions were (a) increasing production efficiency and (b) favoring taxation for green products and services. The main challenges included losing competitive advantage, coping with crises, and the need for long-term planning and significant investments. Pressure from non-political stakeholders and increased innovation were associated with higher odds of viewing the green transition as an opportunity. The authors emphasize the importance of innovation by which the movement toward carbon neutrality is accompanied by technological advancement/digitalization as a twin transition.

4. Discussion

The Special Issue on "The Path to Sustainable Technological Entrepreneurship" addresses a crucial intersection of technology and sustainability, focusing on how new technological solutions can contribute to sustainable development goals across various sectors. The overarching theme of this collection emphasizes the need for an integrated approach that combines technological innovation with strategic policymaking and community engagement to tackle the multifaceted challenges of sustainability.

Sustainability in technological entrepreneurship is not just about creating eco-friendly technologies, but also involves designing systems that are economically viable and socially beneficial. The key developments discussed span a wide range of industries, from traditional manufacturing to high-tech sectors, highlighting the diverse applications of sustainable technologies. These innovations are crucial for transitioning to a circular economy, where waste is minimized and materials are continually reused. Additionally, the role of digital technologies and platforms in accelerating the adoption of sustainable practices has been emphasized, illustrating a shift towards more integrated and interconnected systems.

5. Future Research

Given the complex and evolving nature of sustainable technological entrepreneurship, several fields seem to require further exploration:

- Technology Adoption Barriers: Understanding the barriers to adopting new technologies in different socio-economic contexts is essential. Future research should investigate the economic, cultural, and regulatory factors that influence technology adoption rates.
- Impact Assessment: More comprehensive methods for assessing the social, economic, and environmental impacts of sustainable technologies are needed. This includes

developing new metrics and indicators that can provide a clearer picture of the long-term effects of these technologies.

- Policy and Governance: There is a significant need for research into effective governance frameworks that can support the scaling of sustainable technologies. This includes studies on how policies can be designed to be flexible and adaptive to technological changes.
- Collaborative Models: Exploring new models of collaboration between governments, businesses, academia, and civil society that can accelerate innovation and the deployment of sustainable technologies. This research should investigate how these models can facilitate knowledge sharing and joint problem solving.
- Education and Training: As new technologies emerge, there is a growing need for educational programs that can prepare the workforce for the upcoming changes. Research into the most effective ways to integrate sustainability into educational curricula at various levels could provide valuable insights.
- Cultural Shifts: Investigating how cultural perceptions of technology and sustainability impact the development and acceptance of new technologies. This includes exploring how cultural narratives around technology and progress can be shifted towards more sustainable practices.

By pursuing the exploration of these fields, future research can help build a more robust understanding of how technological entrepreneurship can be leveraged for sustainable development, ensuring that it contributes effectively to global economic, social, and environmental goals.

This timely Special Issue will contribute to the development of information and discourse about sustainable ecological and social provisioning. We believe it is needed to support the fundamental basic economic problems in the 21st century.

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